NASA Procedural Requirements

COMPLIANCE IS MANDATORY

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Responsible Office: Office of the Chief Health & Medical Officer

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Chapter 4. Environmental Health

4.1 General

4.1.1 Policy

4.1.1.1 NASA Centers shall comply with the following applicable regulations and standards:

a. The Occupational Safety and Health Administration (OSHA) standards promulgated under Section 6 of the OSH Act of 1970;

b. 10 CFR, Chapter I, Nuclear Regulatory Commission;

c. 21 CFR Part 120, Hazard Analysis and Critical Control Point Systems; and

d. Consensus standards and recognized industry standards (e.g., American Conference of Governmental Industrial Hygienists Threshold Limit Values and Biological Exposure Indices for Chemical Substances and Physical Agents; American National Standard Institute (ANSI); the National Council on Radiation Protection (NCRP); etc).

4.1.1.2 Centers may pursue variances to OSHA and NASA standards and adopt supplemental/alternate standards as per 29 CFR 1960 and NPR 8715.1, NASA Occupational Safety and Health Program requirements.

4.1.2 Recordkeeping

4.1.2.1 Centers shall keep designated records to evaluate trends and outcomes; validate the effectiveness Environmental Health (EH) programs, document training and pertinent EH events, and provide a mechanism for active managerial control over EH programs.

4.1.2.2 All required records shall be complete, accurate, timely, and appropriate for the task and provide for a continuity of information.

4.1.2.3 All required records shall not be obliterated. When corrections are needed, a line shall be struck through the error, a correction effected, and a notation explaining the correction added. Corrections to electronic databases shall be traceable.

4.1.2.4 All EH and EH-related records shall be subject to review for quality and consistency by the Office of the Chief Health and Medical Officer (OCHMO) EH representatives and OSHA personnel when requested during a site visit or compliance inspection. Records shall be made available to employees, former employees, and their representatives upon request.

4.1.2.5 Centers shall generate, retain, and dispose of EH records according to NASA records requirements, the specific requirements of this chapter, and 29 CFR 1960, Subpart I, Recordkeeping and Reporting Requirements.

4.1.2.6 Records containing individuals' personal information shall be safeguarded in accordance with 5 U.S.C. 552a, the Privacy Act of 1974; and shall be maintained and dispositioned in accordance with NPR 1441.1, NASA Records Retention Schedules.

4.1.3 Emergency Preparedness

4.1.3.1 The Agency Security and Program Protection organization shall coordinate with the OCHMO on EH emergency preparedness efforts and requirements as requested. Corresponding Center Security and Program Protection counterparts shall coordinate with and support Center EH emergency preparedness efforts and requirements.

4.1.3.2 Center EH organizations shall develop emergency preparedness plans to implement their roles and responsibilities specified in the Center Emergency Preparedness Plan.

4.1.3.3 Center EH organizations shall participate in pertinent Center drills, followed by lessons learned to be used to improve EH emergency responses.

4.1.4 Designated Agency Safety and Health Official (DASHO) Notification Requirements.

4.1.4.1 Centers shall inform the DASHO immediately by the most expeditious means, with a simultaneous copy to the Senior Environmental Health Officer, of the following:

a. Events involving a work-related employee death or in-patient hospitalization of an employee;

b. Official visitations by any Federal or state safety or EH-related agency to Centers or any NASA facilities;

c. Center refusal of entry of any Federal or state safety or EH-related agency for an inspection;

d. Receipt of Federal or state safety or EH-related agency citations;

e. Health and safety-related reports of reprisal or discrimination;

f. Reports of Immediately Dangerous to Life and Health (IDLH) working conditions; and

g. Health and safety-related warrants/subpoenas.

4.1.4.2 Centers shall inform the DASHO of the results of OSHA inspections and investigative reports of OSHA reportable events, within ten (10) days, by letter, e-mail, or facsimile with copies to the Agency Office of Safety and Mission Assurance (OSMA).

4.1.4.3 Centers shall inform the DASHO of corrective action reports of OSHA reportable events and replies to OSHA inspections and reports of unsafe working conditions that are unresolved in 30 days, by letter, e-mail, or facsimile within 30 days with copies to the Agency OSMA.

4.1.5 OCHMO Notification Requirements

4.1.5.1 In addition to the DASHO notification requirements, notifications to the OCHMO shall be made to the Senior Environmental Health Officer (SEHO). Centers shall inform the SEHO of EH coordination, partnering, collaboration, agreements, etc., with any Federal agency (examples: FDA, NIOSH, EPA, DOT, NRC, etc.), within ten (10) days, by letter, e-mail, or facsimile.

4.1.6 Training and Certification

4.1.6.1 All personnel shall be appropriately trained for the tasks they perform and shall meet at least the minimum applicable regulatory requirements for training and certification.

4.1.6.2 Specifically, the requirements of OSHA Publication, OSHA 2254, Training Requirements in OSHA Standards, and Training Guidelines shall be met. Safety and health inspectors shall meet the requirements of 29 CFR 1960.25, Qualifications of Safety and Health Inspectors and Agency Inspections, and NPR 8715.1, NASA Safety and Health Program.

4.1.6.3 Agency personnel in charge or responsible for EH aspects shall be trained in accordance with the following OSHA requirements:

a. Top Agency management officials: 29 CFR 1960.54, Training of Top Management Officials;

b. Agency supervisors: 29 CFR 1960.55, Training of Supervisors;

c. Safety and health specialists: 29 CFR 1960.56, Training of Safety and Health Specialists;

d. Safety and health inspectors: 29 CFR 1960.57, Training of Safety and Health Inspectors;

e. Collateral duty safety and health inspectors and safety and health committee members:

29 CFR 1960.58, Training of Collateral Duty Safety and Health Personnel and Committee Members; and

f. Employees and employee representatives: 29 CFR 1960.59, Training of Employees and Employee Representatives.

4.1.7 EH Budget and Resources

4.1.7.1 The NASA Administrator shall ensure that the Agency budget submission includes appropriate financial and other resources to effectively implement and administer the Agency's EH program, per 29 CFR 1960.7, Financial Management.

4.1.7.2 The DASHO, NASA Program Managers, and Center Directors, safety and health officials at all appropriate levels, and other management officials shall be responsible for planning, requesting resources, implementing, and evaluating EH program budgets in accordance with

29 CFR 1960.7(b) and the regulations of the Office of Management and Budget Circular A-11 (sections 13.2(f) and 13.5(f) and other relevant documents.

4.1.7.3 Resources for EH programs shall include, but not be limited to, the following, in accordance with 29 CFR 1960.7(c):

a. Sufficient personnel to implement and administer the program at all levels, including necessary administrative costs such as training, travel, and personal protective equipment;

b. Abatement of unsafe or unhealthful working conditions related to Agency operations or facilities;

c. Safety and health sampling, testing, and diagnostic and analytical tools and equipment, including laboratory analyses;

d. Any necessary contracts to identify, analyze, or evaluate unsafe or unhealthful working conditions and operations;

e. Program promotional costs such as publications, posters, or films;

f. Technical information, documents, books, standards, codes, periodicals, and publications; and

g. Medical surveillance programs for employees.

4.2 Occupational Exposure Limits (OEL's)

4.2.1 Policy

4.2.1.1 At a minimum, NASA shall follow all OSHA standards promulgated under Section 6 of the OSHA Act of 1970, including the Permissible Exposure Limits (PEL's) for hazardous airborne contaminants identified in 29 CFR 1910 Subpart Z.

4.2.1.2 To more fully protect the NASA workforce, OEL's recommended and established by other acknowledged authorities or those developed specifically by NASA shall also be used.

NOTE: While the OSHA PEL's carry the weight of law, the majority of them were adopted in 1970 from 1968 consensus values and do not necessarily reflect current scientific data. Additionally, there currently are PEL's established for approximately 400 chemicals. This is a relatively small percentage of the thousands of chemicals that exist. For these reasons, use of OEL's is necessary and prudent.

4.2.2 Responsibilities

4.2.2.1 The Chief Health and Medical Officer (CHMO) shall provide oversight in the area of OEL's and shall assess compliance with this policy.

4.2.2.2 CHMO shall provide technical support to NASA Centers in developing OEL's where none exist. Support may be in the form of reference materials, literature searches, consultation with experts, etc.

4.2.2.3 CHMO shall notify all Centers when an OEL is established by one Center for a specific chemical so they can assess its applicability to their operations.

4.2.2.4 Centers shall be responsible for monitoring the workplace and workforce and to select the most appropriate and protective OEL's for the work being performed and ensuring people with appropriate training implement OEL's. They are also responsible for developing and recommending OEL's in the

absence of an existing OEL for a specific chemical.

4.2.3 Process Description

4.2.3.1 NASA Centers shall utilize OSHA PEL's, Threshold Limit Values (TLV) issued by the American Conference of Governmental Industrial Hygienists (ACGIH) or specific NASA Health Standards issued by the OCHMO, whichever is more stringent.

4.2.3.2 In the absence of a specific PEL, TLV, or NASA Standard, other sources of OEL's shall be utilized. These include the following: (1) National Institute for Occupational Safety & Health's (NIOSH) Recommended Exposure Limit (REL); (2) American National Standards Institute (ANSI) Standards; (3) National Academy of Science Recommendations; (4) American Industrial Hygiene Association (AIHA) Workplace Environmental Exposure Level (WEEL); (5) Environmental Protection Agency Recommendations; (6) Deutsche Forschungsgemeinschaft (German Commission for the Investigation of Health Hazards of Chemical Compounds in the Work Area) Maximum Allowable Concentration; (7) British Health & Safety Commission and Health & Safety Executive. Occupational Exposure Limits, and (8) Chemical Manufacturers recommend exposure values.

4.2.3.3 When no established OEL exists for a specific chemical, a working OEL shall be established based on a thorough examination of the data available for that chemical and by following established industrial hygiene exposure limit setting guidelines. Only professionals that possess the appropriate degree of knowledge, experience, and professional judgment (e.g., a Certified Industrial Hygienist) shall establish a working OEL. This process shall take into account chemical analogy, animal experimentation and extrapolation, and human experience and epidemiological data.

4.2.3.4 All of the available data shall be thoroughly documented. A written rationale that considers, summarizes, and weighs the importance of all data shall be produced. Additionally, experience and professional judgment shall be applied to weigh all information and apply an appropriate safety factor, based on the strength of the available data, before an OEL is recommended.

4.3 Occupational Exposure Assessment and Management

4.3.1 Policy

4.3.1.1 NASA Centers shall employ a systematic and comprehensive approach to exposure assessment to anticipate, recognize, evaluate, and control health hazards in the workplace and effectively and proactively manage Industrial Hygiene (IH) programs.

4.3.2 Responsibilities

4.3.2.1 The CHMO shall provide oversight in the area of Occupational Exposure Assessment and Management, assess compliance with this policy, and provide leadership in this area by working to standardize data collection across the Agency.

4.3.2.2 CHMO shall assess Center compliance with the Occupational Exposure Assessment and Management policy.

4.3.2.3 Centers shall establish and implement an effective Exposure Assessment and Management Program as outlined in this policy.

4.3.3 Process Description

4.3.3.1 All Center Environmental Health (EH) programs shall establish a written Occupational Exposure Assessment and Management Program whose purpose is to collect and organize available information on the workplace; the workforce; chemical, physical, and biological agents; existing controls; historical exposure data; biological monitoring data; and any other available source of information such as OEL's. This written program shall also include program goals and objectives.

4.3.3.2 The outcome of this exposure assessment effort shall be a complete summary of available, essential information on workers, tasks, agents, potential exposures (factoring in frequency and duration) and potential health effects.

4.3.3.3 All Center programs shall create similar exposure groups (SEG's) and define exposure profiles for the identified exposure groups. All potentially exposed employees shall be in a minimum of one identified exposure group.

4.3.3.4 A determination shall be made about the acceptability, unacceptability, or uncertainty of the exposure profile defined for each SEG. Uncertain exposures lead to further information gathering. Unacceptable exposures lead to control of the exposure. Acceptable exposures lead to a programmed reassessment.

4.3.3.5 Exposure groups with unacceptable exposures shall be prioritized and a strategy developed for control.

4.3.3.6 The exposure assessment program shall have a component that involves continual information gathering for the purpose of setting priority on exposure groups for additional characterization and further information gathering. This can be either qualitative or quantitative information and is used to enhance the basic characterization and better define exposure groups, their profile, and the risk posed by the exposure profile.

4.3.3.7 When monitoring data is collected, statistical tools (such as the AIHA tool or lognorm) shall be used to aid in understanding the data and to assist in interpretation and decision making.

4.3.3.8 All workers shall be protected using personal protective equipment (PPE) or administrative controls while long-term controls are being implemented.

4.3.3.9 Exposures shall be periodically re-characterized and reassessed in order to update exposure groups and exposure profiles.

4.3.3.10 The following records shall be maintained to document compliance with this chapter in accordance with applicable NASA recordkeeping requirements:

a. Lists of SEG's;

b. Exposure profiles; and

c. Judgments of acceptability.

4.4 Sampling, Analytical Methods, and Equipment Calibration

4.4.1 Policy

4.4.1.1 Critical data integrity shall be ensured by adherence to OSHA, NIOSH, or other recognized sampling and analytical methods using properly calibrated equipment with National Institute of Standards and Technology (NIST) traceability.

4.4.2 Responsibilities

4.4.2.1 The OCHMO shall assess the quality, consistency, and effectiveness of Center programs addressing proper sampling technique, analytical methods, and equipment calibration.

4.4.2.2 Centers shall develop appropriate policy and procedures to ensure that proper sampling techniques, analytical methods, and equipment calibration are used throughout the data collection process.

4.4.3 Process Description

4.4.3.1 Centers shall develop a written policy and procedures for Sampling, Analytical Methods and Equipment Calibration utilizing methods established by professional or regulatory bodies. At a minimum, these requirements shall address sample planning, sampling methodology, pre-survey calibration, survey performance, sample collection, post-survey calibration, sample documentation, shipment of sample media, equipment calibration and maintenance, and recordkeeping.

4.4.3.2 Engineering, administrative, and PPE controls shall be applied as appropriate whenever a sample exceeds the OSHA permissible exposure limit or the ACGIH threshold limit value, or other established OEL. Engineering controls shall be applied first. If engineering controls are not feasible, administrative controls shall be used. PPE shall be used as a last control measure.

4.4.3.3 All results shall be recorded and maintained in accordance with OSHA or NASA recordkeeping requirements, whichever is more stringent.

4.5 Reproductive and Developmental Health

4.5.1 Policy

4.5.1.1 NASA shall protect the reproductive health of all employees, students, and visitors from occupational exposures to substances (chemical, biological, radiological, or physical) known or suspected of being capable of posing a hazard to human reproduction and identify potential reproductive and developmental hazards and implement appropriate exposure control measures.

NOTE: This includes protection of the unborn.

4.5.1.2 NASA shall keep exposures as low as reasonably achievable since short-term exposures to

reproductive hazards can result in long-term health effects and a developing fetus may also be adversely affected by exposures lower than those generally considered safe for adults.

4.5.3 Responsibilities

4.5.3.1 The CHMO shall establish and maintain a Developmental and Reproductive Health Protection policy that is reflective of Federal guidance, provides coordination and communication with the NASA Centers, and provides technical and subject matter expertise.

4.5.3.2 The CHMO shall provide Developmental and Reproductive Health Protection oversight and assess compliance with this policy.

4.5.3.3 Centers shall develop, implement, administer, and maintain a written Developmental and Reproductive Health Protection Program that is designed to ensure employees and their unborn children are adequately protected from recognized hazards.

4.5.4 Process Description

4.5.4.1 Written developmental and reproductive health protection guidelines shall include provisions for:

a. Evaluating areas where potential chemical, biological, or physical reproductive hazards exist and determine extent of potential exposures;

b. Recommending procedures to reduce workplace exposures to reproductive hazards (i.e., engineering controls, use of PPE, job rotation, etc.);

c. Providing training on chemical, physical, and biological reproductive hazards in the work area, including proper use of PPE, safety devices, etc., and other methods of decreasing exposure;

d. Providing information regarding reproductive hazards in the workplace;

e. Providing specific radiation safety training, including information on declaration of pregnancy for radiological issues;

f. Implementing measures (for declared pregnancies) to achieve the lower exposure limit (0.5 rem to embryo/fetus during entire gestation period) and conduct dose monitoring;

g. Managing written declaration of pregnancies for workers exposed to radiological hazards.

NOTE: See Section 4.15 of this Chapter for more information on radiation;

h. Ensuring that known reproductive hazards specific to a work area are included in the written job description;

i. Ensuring that supervisors provide individual operation training;

j. Maximizing employee privacy when implementing the elements of the program;

k. Notifying Occupational Medicine regarding areas with potential exposures for medical surveillance purposes or EH regarding areas requiring a workplace hazard assessment; and

l. Ensuring that alternate job duties are considered when indicated by Occupational Medicine, designating the person responsible for arranging reasonable accommodations, if available, and designating the person responsible for counseling the employee about other options, including sick leave and family leave when a reasonable accommodation is not available.

4.5.4.2 The Center EH organization shall perform a workplace hazard assessment upon the request of an employee or when it is necessary to ensure existing controls (engineering, administrative, and PPE) are adequate to protect the employee from reproductive hazards. The hazard assessment shall include:

a. Identification of chemical, biological, physical, or radioactive agents in the workplace that present a potential exposure risk;

b. Qualitative exposure assessment of concerned employee;

c. Review of work practices and PPE used, and recommend additional control measures if needed; and

d. Review of past EH reports and historical sampling results, if available.

4.6 Nanotoxicology

4.6.1 Policy

4.6.1.1 Since nanomaterials may pose unusual risk to human health due to their unique composition, reactivity, size, and ability to cross cell membranes, NASA shall ensure that all work with manufactured nanomaterials is prudently conducted in a manner that is responsible and safe.

4.6.2 Responsibilities

4.6.2.1 The CHMO shall establish and maintain a Nanotoxicology policy that reflects Federal and best practice initiatives, provide coordination and communication with the NASA Centers, and provide technical and subject matter expertise.

4.6.2.2 The CHMO shall provide Nanotoxicology program oversight and assess compliance with this policy.

4.6.2.3 Center Occupational Health (OH) Managers shall ensure that they have a written Nanotoxicology program (if needed), designed and implemented to ensure all work with manufactured nanomaterials minimizes exposures As Low As Reasonably Achievable (ALARA) or other exposure standards described in Section 4.2. This program can be a part of the Chemical Hygiene Plan already required by 29 CFR 1910.1450 and/or hazard review processes at the Center (Safety Permit process, etc.).

4.6.3 Process Description

4.6.3.1 All Centers shall have a written Nanotoxicology program (if needed) that encompasses the requirements of this section.

4.6.3.2 Transportation, storage, use, and disposal of manufactured nanomaterials shall be conducted in accordance with all Federal, state, and local requirements.

4.6.3.3 Laboratory personnel shall be informed of the risks associated with workplace hazards through training programs, material safety data sheets, and labeling and signage.

4.6.3.4 Use of any manufactured nanomaterials that are defined as "chemical substances" under the Toxic Substances Control Act (TSCA) and which are not on the TSCA Inventory shall be reported to the U.S. Environmental Protection Agency (EPA). A Pre-manufacture Notice shall be submitted to the EPA by anyone intending to manufacture or import a chemical substance that is not on the TSCA Inventory of Chemical Substances.

4.6.3.5 All U.S. Food and Drug Administration (FDA) regulations applying to products that utilize nanotechnology or contain manufactured nanomaterials shall be followed.

4.6.3.6 Hazard Assessments shall be conducted prior to beginning work with manufactured nanomaterials by a qualified industrial hygienist to identify appropriate work procedures, controls, and personal protective equipment to ensure worker safety. The assessment shall evaluate several factors, including, but not limited to, the physical and chemical properties of the nanomaterial, the process by which the material will be generated and/or used, and existing engineering controls (e.g., fume hood, glove box).

NOTE: In some instances, the industrial hygienist may recommend collecting occupational exposure measurements (e.g., sampling) to further understand potential hazards or to identify specific processes or equipment requiring additional engineering controls.

4.6.3.7 All exposures to manufactured nanomaterials shall be kept to a minimum by utilizing the basic hierarchy of controls described below.

a. Engineering. In order to provide a safe work environment for faculty, staff, students, and visitors, engineering controls must be maintained wherever manufactured nanomaterials are used or stored. These controls may include local exhaust ventilation and localized filtration.

b. Respiratory protection. When local exhaust ventilation and filtration is not available or feasible for work involving manufactured nanomaterials, respiratory protection shall be utilized. However, the preferred method for manipulating manufactured nanomaterials is in solution, and every effort should be made to design and implement effective engineering controls for any operation where manufactured nanomaterial are used.

c. Work Practices. The incorporation of good work practices helps to minimize exposure to manufactured nanoparticles.

d. Administrative. Although traditional PEL's exist for many of the substances that manufactured nanomaterials are made from, the PEL for a nanomaterial of these substances is not yet clear. Thus, it is important to incorporate administrative controls into most all operations.

e. PPE. Typical chemistry laboratory apparel and PPE shall be worn when working with manufactured nanomaterials. This includes long pants, shirts, and shoes, as well as safety glasses, laboratory coats,

and gloves. Open sandals, shorts, and skirts are prohibited.

4.6.3.8 Spill management shall be addressed emphasizing that all debris resulting from the cleanup of a manufactured nanomaterial spill shall be handled as though it were hazardous and include procedures for access control and cleanup of both dry and wet materials.

4.6.3.9 Waste disposal shall be addressed, focusing on characterization of the manufactured nanomaterial waste as either hazardous or non-hazardous, packaging, labeling, or transportation requirements as appropriate.

4.7 Control of Hazardous Substances and Articles Acquisitions

4.7.1 Policy

4.7.1.1 It is NASA's policy to evaluate the potential health and safety compliance and exposure issues involved with the use of hazardous substances and articles at NASA and set hazard controls prior to acquisition of these substances and articles. This includes acquisition of hazardous substances and articles via all types of procurements, including credit card purchases, donations, open orders, gifts, free samples, and other acquisitions of hazardous substances and articles. This section also includes hazardous substances and articles that are otherwise brought onto NASA-managed property.

4.7.2 Responsibilities

4.7.2.1 The OCHMO shall periodically monitor Center programs, which provide for overall hazardous substance/article control, including evaluation of Center controls over procurements of hazardous substances/articles during regular OH reviews.

4.7.2.2 NASA Centers shall be responsible for the following:

a. Administering and identifying baseline hazardous substance and article acquisition programs;

b. Maintaining and monitoring the effectiveness of hazardous substance and article acquisition programs, including all mechanisms for acquisition of hazardous substances and articles;

c. At least annually, auditing the records of purchases to ensure all hazardous substances and articles acquisitions are being reviewed and approved by competent persons and health and safety requirements for acquisitions are being properly implemented prior to acquisition;

d. Complying with OSHA, EPA, Nuclear Regulatory Commission (NRC), Department of Transportation (DOT), and other pertinent regulatory requirements for the acquired hazardous substances and articles;

e. Following the manufacturer's product recommendations and requirements;

f. Monitoring conformance with the requirements of this section and reporting nonconformances to Center or Facility managers; and

g. Assuring the requirements of this section are included in all contract procurements, with provisions to extend the requirements to subcontracts.

4.7.2.3 Competent Persons are responsible for reviewing procurements of hazardous substances and articles and coordinating with Center safety and health organizations to:

a. Identify baseline hazards associated with the acquisition;

b. Identify alternatives, where available, to reduce risk;

c. Determine safety and health requirements for the safe use of the material/equipment; and

d. Disapprove acquisitions of hazardous substances/articles that cannot be safely used.

NOTE: A Competent Person is a person who has acquired through training, qualification, or experience, the knowledge and skills to identify hazardous substances/articles being requested for acquisition, and the ability to manage those purchased and brought oncenter.

4.7.3 Process Description

4.7.4.1 This section describes the minimum requirements that Centers shall implement for safe acquisition of hazardous substances and articles.

4.7.4.2 Each Center shall implement a means to positively control and regulate acquisitions of hazardous substances and articles.

4.7.4.3 Each Center shall implement a means to hold purchasers and receivers accountable for the

proper and safe acquisition of hazardous substances and articles.

4.7.4.4 The following provisions shall be implemented prior to acquisition:

a. Use of a less hazardous substance or article, if one can reasonably be substituted;

b. Acquisition of the smallest reasonable amount, size, activity, or hazard potential;

c. Approval of the acquisition by a Competent Person; and

d. Completion of hazard determinations, training, and other pertinent preparations adequate to assure safe use.

4.7.4.5 Competent Persons shall be authorized by the Center or Facility to acquire hazardous substances or articles.

4.7.4.6 Only Competent Persons shall approve acquisitions of hazardous substances and articles.

4.7.4.7 Competent Persons shall have the authority to deny acquisitions of hazardous substances and articles until potentially significant hazardous conditions are eliminated or controlled.

4.8 Hearing Conservation

4.8.1 Policy

4.8.1.1 This section establishes minimum requirements for an Agency-wide Hearing Conservation Policy. It outlines NASA's requirements for primary prevention of noise-induced hearing loss where employees are occupationally exposed to hazardous noise in all occupational settings, including all ground-based operations and all aircraft operations. This section does not apply to space flight operations.

4.8.1.2 The requirements of the latest revision of 29 CFR 1910.95, Occupational Noise Exposure Hearing Conservation Amendment Final Rule and appendices, and the requirements of the latest revision of 29 CFR 1904.10, Occupational Injury and Illness Recordkeeping and Reporting Requirements, for cases involving occupational hearing loss are incorporated herein by reference and shall be followed unless otherwise specified in this section.

4.8.1.3 Where conflicts exist between other NASA health and safety requirements, 29 CFR 1910.95, Occupational Noise Exposure Hearing Conservation Amendment Final Rule and appendices, 29 CFR Part 1904.10, Occupational Injury and Illness Recordkeeping and Reporting Requirements, and this section, the most protective requirements shall apply.

4.8.1.4 Centers shall take steps to inform and protect all personnel (including aircraft pilots and crew members) from potential risks to their hearing that may be encountered in, or derived from, the workplace.

4.8.1.5 Centers shall have a written Hearing Conservation Program (HCP) which, at a minimum, addresses and applies the requirements and provisions of this section and requires their contractors to have HCPs in accordance with the NASA FAR Supplement 1852.223-70, Safety and Health.

4.8.1.6 Centers shall have OH personnel with knowledge in sound analysis, noise exposure assessment, hearing protection, audiometric testing, and noise abatement strategies.

4.8.1.7 Occupational health personnel shall review their Center's HCP, including the hearing conservation training program, for adequacy at least every three (3) years and more frequently if program requirements change. All reviews shall be documented and available for audit by OCHMO staff.

4.8.1.8 Centers shall implement a "Buy Quiet and Quiet by Design" program.

4.8.1.9 Centers shall implement a system to effectively prioritize noise surveys and noise remediation efforts as part of their HCP and in accordance with the provisions of this section.

4.8.1.10 Communication and coordination between and among Center managers, supervisors, employees, engineers, environmental health personnel, and the Medical Director shall be implemented to properly identify, evaluate, and control hazardous noise exposures.

4.8.1.11 Center Directors and affected program and project managers shall be notified of all operations and equipment not conforming to this section or the Center's HCP.

4.8.1.12 All definitions in 29 CFR 1910.95, Occupational Noise Exposure, Appendix I, shall be applicable to this document unless otherwise defined in Appendix A of this NPR.

4.8.2 Responsibilities

4.8.2.1 The DASHO shall ensure the provision of resources for the development and review of the Agency's Hearing Conservation Policy and for implementation of the OCHMO's responsibilities contained therein.

4.8.2.2 The Agency Director of Occupational Health shall provide direction for, and approval of, the Agency's Hearing Conservation Policy.

4.8.2.3 The Senior Environmental Health Officer shall:

a. Make recommendations and provide advice concerning hearing conservation to the Director, Agency Occupational Health Program, and the DASHO when requested, and

b. Review the adequacy of HCPs at each Center as per Chapter 9, Audit Process.

4.8.2.4 The Chief Engineer and the Assistant Administrator for Infrastructure and Administration shall ensure that "Buy Quiet and Quiet by Design" provisions are integral to the site selection and design of new or modified facilities and equipment.

4.8.2.5 The Assistant Administrator for Procurement shall ensure that "Buy Quiet and Quiet by Design" provisions are included in all contracts and in the purchase of new equipment, as appropriate.

4.8.2.6 Center Directors, Component Facility Directors, and the Assistant Administrator for Infrastructure shall ensure the following:

a. Adequate resources are provided to implement Center HCPs; and

b. Approved HCPs are implemented at their Centers.

4.8.2.7 Facility Managers, design engineers, occupational health personnel, and employers of affected employees shall implement the provisions of their Center's HCP.

4.8.2.8 Contracting Officers shall ensure that Center contract requirements include provisions for written HCPs in accordance with the NASA, FAR Supplement 1852.223-70, Safety and Health.

4.8.2.9 Medical Directors shall ensure that all medical examinations relative to occupational noise are properly performed, appropriate records maintained; and that all examination results are communicated to the employee as specified herein.

4.8.3 Process Description

4.8.3.1 At a minimum, the written HCP, specified in Section 4.8.1.5, shall include provisions for:

a. Specifying the individual responsibilities of Facilities Managers, Design Engineers, Occupational Health Personnel, Supervisors, and Employees;

b. Assuring that noisy areas are surveyed to determine if they are hazardous noise areas;

c. Affirming the criterion sound level and exchange rate;

d. Evaluating and maintaining the HCP's effectiveness;

e. Implementing "Buy Quiet and Quiet by Design" Programs;

f. Exposure monitoring;

g. Medical surveillance, including audiometric testing, review, and medical followup;

h. Notification and coordination between employees, management, and occupational health personnel of noise exposure and dosimetry monitoring and survey results, operational and design plan review results, the addition of new equipment or new operations, and any work-related STS.

i. Selection, use, cleaning, and inspection of hearing protectors;

j. Training for employees and supervisors of employees enrolled in an HCP;

k. Council for Accreditation of Occupational Hearing Conservation (CAOHC) Certification of Occupational Hearing Conservationists;

l. Recordkeeping and access to information as per NPR 1441.1, NASA Records Retention Schedules and Privacy Act requirements;

m. Policy documentation;

n. Noise control requirements and strategies;

o. Effective implementation of engineering, operational, and administrative controls; and

p. Appropriate corrective actions for employees who violate requirements of this section, the Center's HCP requirements, or 29 CFR 1910.95, "Occupational Noise Exposure Hearing Conservation Amendment Final Rule," and appendices.

4.8.3.2 Whenever an employee is occupationally exposed to noise equal to or exceeding the NASA action level of 82 dBA Time-Weighted Average (TWA) for 30 days or more per year or can be expected to be exposed to 85 dBA TWA for any one day, Centers shall administer a continuing, effective HCP in conformance with the requirements of this section with all the affected employees included in the program. Exposures shall be computed without regard to any attenuation provided by the use of personal protective equipment.

4.8.3.3 NASA's allowable noise exposure limit is the equivalent to an 85 dBA, 8-hour TWA exposure using a 3 dB exchange rate as shown in Table 1 below.

Table 1
Noise Exposure Limits

Exposure level (dBA)	Hours	Minutes	Seconds
81	20	10	0
82	16	0	0
83	12	42	0
84	10	5	0
85	8	0	0
86	6	21	0
87	5	2	0
88	4	0	0
89	3	10	0
90	2	31	0
91	2	0	0
92	1	35	0
93	1	16	0
94	1	0	0
95	0	47	37
96	0	37	48
97	0	30	0
98	0	23	49
99	0	18	59
100	0	15	0

a. Table 1 contains noise exposure levels and durations that are equivalent to this limit as calculated by the following formula where L stands for exposure level and T for duration: $T (min) = 480/2^{(L-85)/3}$;

b. Exposures exceeding the equivalent exposures in Table 1 shall be controlled, reduced, or eliminated through a hierarchical combination of engineering controls, administrative controls, and hearing protection devices;

c. Noise dose shall include all impact/impulse noise measured up to and including 140 dB peak; and

d. The action level is 82 dBA, 8 hour TWA.

4.8.3.4 "Buy Quiet and Quiet by Design" Programs shall:

a. Meet realistic and achievable baseline noise criteria and optimize noise emission criteria based on individual and specific operational and site conditions;

b. Encompass design and development, or selection and purchase, of a broad variety of fixed and portable equipment purchased for use by Centers, including equipment purchased by contractors, to minimize noise-exposure hazards to personnel;

c. Require all equipment expected to produce noise which is approaching hearing conservation levels of 80 dBA and higher under a variety of site and operational considerations.

d. Identify noise emission and control requirements for equipment procurement, specifications, and design;

e. Contain provisions for "Buy Quiet and Quiet by Design" program support, promotion, training, and management sponsorship;

f. Be individualized to meet Center-specific needs, configuration, and other relevant factors;

g. Contain provisions for a documented waiver process that accommodates specialized research project items or flight hardware.

4.8.3.5 Engineering Controls shall:

a. Be the first and primary means of controlling hazardous noise. The feasibility and cost of engineering controls may be considered when making decisions about these controls;

b. Attempt to reduce noise emissions (measured at operator position or equivalent) to below 85 dBA; and

c. Be reviewed to assess the adequacy of precautions that are planned and/or undertaken to control noise exposures.

4.8.3.6 Engineering projects, drawings, and operational plans, including noise control measures, shall be coordinated with affected management organizations and occupational health personnel in the early stages of the design and/or planning process and prior to contract award and/or authority to proceed.

4.8.3.7 Organizations responsible for introducing changes to facilities, operations, or procedures shall notify occupational health personnel of:

a. Any changes in operations or equipment that increases noise levels; and

b. Any new, uncontrolled, or previously unidentified areas, operations, or equipment that may produce hazardous noise or may not comply with the requirements of this section.

4.8.3.8 If engineering controls fail to reduce sound levels within the requirements specified in this section, administrative controls shall be utilized. Examples of administrative controls include access restrictions and time limitations in the hazardous noise area. Specific requirements for administrative controls include:

a. Maximizing the distance between the employee and the hazardous noise source to the extent practical; and

b. Identifying hazardous noise areas according to the following criteria:

(1) Areas determined to be hazardous noise areas shall be identified by posting with signs that conform to 29 CFR 1910.145, Specifications for accident prevention signs and tags requirements.

(2) Signs shall clearly indicate the presence of hazardous noise and state the requirement to wear hearing protection. The signs shall be posted at the entrance(s) to or the periphery of hazardous noise area(s).

(3) Decals or placards with similar statements shall be affixed to power tools and machines that produce hazardous noise levels, and caution signs shall be posted in areas where hazardous noise-producing tools and machines are used.

4.8.3.9 If both engineering and administrative controls fail to reduce sound levels to 85 dBA, 8-hour TWA or below, personal hearing protection shall be used to bring exposures to acceptable levels in accordance with the following:

a. All personnel who enter designated areas or who perform tasks where exposure to noise is greater than or equal to 82 dBA, regardless of the duration of exposure, shall be provided with personal hearing protection;

b. All personnel who enter designated hazardous noise areas or who perform tasks where exposure to noise is greater than or equal to 85 dBA or 140 dB peak, regardless of the duration of exposure or number of impulses, shall be provided with and required to wear personal hearing protection;

c. Earplugs shall be for the exclusive use of each employee and shall not be traded or shared;

d. Hearing Protection Devices (HPDs) shall attenuate employee noise exposure to an 8-hour, TWA of 85 dBA or less. For those employees with a Standard Threshold Shift (STS), HPDs shall attenuate exposure to an 8-hour, TWA of 82 dBA or less. HPD attenuation shall be determined by one of the following methods:

(1) The published Noise Reduction Rating (NRR) value may be used in accordance with the guidance in this section. When using the NRR of a hearing protector to predict protected exposure levels, the following de-rating criteria shall apply for all types of HPDs, where "NRR" is the manufacturer's Noise Reduction Rating. Required NRR = [(LA - 85) x 2] + 7, where LA is the measured ambient sound level to which the employee is exposed.

(2) Where it is not possible to provide the calculated value of Required NRR in (i) above, the Required NRR may be calculated using the employee's unprotected TWA exposure in place of LA. Required NRR = [(TWA - 85) x 2] + 7, where TWA is the employee's unprotected TWA exposure level. TWA values that are used in the calculation of required NRR shall reflect actual hours worked and all contributions to the employee's exposure.

(3) Real-world attenuation of a particular employee's field-fit HPD may be determined experimentally using a commercial fit-check system or other published method, such as those described in ANSI S12.68. Protected exposures shall be calculated from experimentally-derived attenuation data in accordance with the guidance provided by the particular method chosen.

e. The adequacy of HPD attenuation shall be re-evaluated whenever employee noise exposures increase;

f. Special hearing-protective equipment, such as sound-suppression or noise-cancellation communication headsets, shall be regularly inspected if they are used in hazardous noise areas;

g. Sound-suppression and noise-cancellation headsets that have been damaged, altered, or modified in any way that affect the attenuation characteristics shall not be used; and

h. Where sound-suppression and noise-cancellation headsets are not permanently issued to individuals, such equipment shall be cleaned and sanitized before re-issuance.

4.8.3.10 Noisy areas shall be surveyed to determine if they are hazardous noise areas in accordance with the following requirements:

a. Measurement of potentially hazardous sound levels shall be conducted when any information, observation, or calculation indicates that an employee may be exposed to noise at or above the action level. This includes, but is not limited to, times where there is a need to document representative noise exposures, where employees complain of excessive noise, or where it is difficult to understand a normal conversation when the speaker and listener face each other at a distance of 3 feet;

b. Noise surveys shall also be conducted whenever any changes to facilities, equipment, work practices, procedures, or noise-control measures alter potential noise exposures. A review of hazardous noise sources and controls, employee exposures, and work practices and procedures shall be conducted for changed conditions whenever an employee experiences an STS;

c. In determining TWA exposures, all continuous, intermittent, and impulsive sound levels, from 80 dBA to 140 dBA, shall be integrated into the noise measurements;

d. Octave band analysis shall be conducted, as necessary, to establish the characteristics of the noise source and to help determine appropriate abatement techniques;

e. When a noise survey is performed, it shall determine the presence of compounding hearing-related circumstances present in the environment (e.g., certain solvents, heavy metals, carbon monoxide, heat, and vibration) to ensure proper mitigation;

f. Exposure monitoring shall be conducted when a noise survey shows that any employee or group of employees may be exposed to noise at or above 82 dBA, 8-hour TWA. The purpose of such monitoring is to determine the noise dose of the exposed employee and the representative exposure of similarly exposed employees and to determine appropriate noise abatement techniques;

g. All noise surveys and personal noise dosimetry monitoring shall be conducted in accordance with 29 CFR 1910.95 requirements, unless otherwise specified in this section;

h. Operational plans shall be reviewed to assess the adequacy of precautions that are planned and/or implemented to control noise exposures;

i. Baseline surveys shall be conducted of each operation, job, or procedure having the potential to create hazardous noise;

j. New equipment, operations, jobs, or procedures, with the potential for creating hazardous noise, shall be evaluated with regard to noise emissions prior to operational start up;

k. Employees and/or their representatives shall be provided an opportunity to observe noise dosimetry and area monitoring activities;

l. Affected employees shall be notified in writing of the results of noise dosimetry monitoring;

m. Employers of affected employees and the appropriate occupational health program managers shall be notified when noise measurement data indicate that noise exposures equal or exceed the action level or the limitations of Table 1. Written reports of the hazardous noise surveys that identify all survey observations, findings, and conclusions shall also be provided to affected employees; and

n. Hazardous noise areas shall be selected, surveyed, and documented each year.

4.8.3.11 All instruments used to measure workers' noise exposures shall adhere to the following requirements:

a. All instruments shall be field-calibrated prior to each use;

b. Instruments shall be checked and calibrated at least annually by the manufacturer, a representative of the manufacturer, or an approved laboratory; and

c. Sound-level meters used to measure worker noise exposures shall be set at "slow" response and A-weighting.

4.8.3.12 Audiometric test equipment shall be calibrated to meet the requirements specified in the latest revision of ANSI S3.6, Specification for Audiometers.

4.8.3.13 Ambient noise levels in audiometric test rooms and booths shall meet the specifications in the latest version of ANSI S3.1, Maximum Permissible Ambient Noise Levels for Audiometric Test Rooms.

4.8.3.14 Medical surveillance shall be provided to all employees enrolled in an HCP in accordance with the following requirements:

a. Employees receiving medical surveillance shall undergo a baseline audiometric examination before beginning work assignments in hazardous noise areas;

b. If it is not possible to obtain the baseline prior to noise assignment, then employees shall undergo a baseline audiometric examination within 30 days of initial exposure to hazardous noise. During this 30-day period, employees shall wear personal HPDs, which reduce their exposure to 82 dBA TWA or below. When it is discovered that personnel have already been assigned to a position that may expose them to hazardous noise but have not yet had an audiometric examination, audiometry shall be conducted within 30 days of the discovery, and employees shall wear personal hearing protection that reduces their exposure to 82 dBA TWA or below;

c. Audiometric examinations shall include an audiogram, an otoscopic examination by an audiologist, physician, or CAOHC Certified Occupational Hearing Conservationist to determine any existing medical pathology of the ear, and an update to their medical history (occupational and personal) to document past noise exposure and other otopathological factors;

d. The employee shall have no apparent or suspected ear, nose, or throat problems that might compromise the validity of the audiogram. When an employee has an acute disease that may compromise the validity of the test, the audiogram shall be delayed until the condition has abated;

e. The exposure history taken at the time of the audiometric examination shall include ototoxic medications and exposure to ototoxic substances;

f. Personnel suffering from acute diseases of the ear shall not be placed in hazardous noise areas until the condition has abated, particularly if such diseases preclude the wearing of hearing protectors;

g. Centers shall take all possible measures to assure that employees who have participated in the HCP medical surveillance program receive a final audiometric examination prior to termination of employment, transfer to duties not involving noise exposures, transfer to another installation, or retirement. An annual audiogram, if completed within six (6) months of the termination, transfer, or retirement date, may be substituted for the final audiogram; and

h. When employees at a Center retain their "work role position" but change employers due to contract award to a new employer, all medical records applicable to hearing conservation shall follow them to their new employer, including their current baseline threshold.

4.8.3.15 Audiometric testing shall be performed upon initial assignment, and annually thereafter, in accordance with 29 CFR 1910.95, Sections (g) and (h) and as follows:

a. An audiologist or physician knowledgeable in hearing conservation shall oversee all audiometric testing conducted by CAOHC-certified Occupational Hearing Conservationists;

b. Personnel who conduct audiometric testing shall be familiar with the provisions of this section;

c. All baseline audiograms and confirmation audiograms following the identification of a STS shall be preceded by a period of at least 14 hours during which there is no known exposure to noise above 82 dBA TWA, on or off the job. Hearing protectors that lower workplace noise to the equivalent of 82 dBA TWA, using the appropriate noise-reduction rating, may be used to conform to this requirement;

d. An STS shall be logged as an OSHA-recordable event in accordance with 29 CFR 1904.10 if the answers to ALL of the questions below are "yes:"

(1) Did an annual age-corrected audiogram reveal a STS (10 dB shift or greater, averaging 2k, 3k, and 4k Hz) relative to the baseline audiogram in one or both ears? (Age correction permitted.)

(2) Is the employee's uncorrected hearing threshold level (averaging 2k, 3k, and 4k Hz) 25 dB or greater above audiometric zero in the same ear as the STS? (Age correction NOT permitted.)

(3) Is the STS work-related as determined by physician or other licensed health care professional, in consultation with the employer? This determination must be made in accordance with CFR 1904.5.

e. If during any medical evaluation or audiometric examination, the employee is identified as potentially unable to perform the job safely or has a hearing profile equal to or worse than that listed in Table 2 below, the employee and employer shall receive a written notification of the requirement to perform an Ability and Risk Evaluation. The written notification shall include results of the medical and work history with special emphasis on the association of any health conditions that may impair ability to safely perform the work expected in the position held (e.g., hear commands or signals) or the ability to wear appropriate personal hearing protection equipment in a hazardous noise area.

Table 2

Frequency (Hz)	500	1000	2000	3000	4000	6000
Hearing Threshold Level (dB)	25	25	25	35	45	45

4.8.3.16 The requirements for handling threshold shifts are as follows:

a. The STS may be computed using the age corrections described in OSHA 29 CFR 1910.95, Appendix F;

b. Each employee's annual audiogram shall be compared to his/her baseline audiogram to determine if the audiogram is valid and to determine if an STS has occurred;

c. The baseline of each ear shall be separately tracked;

d. A physician, audiologist, or CAOHC-certified Occupational Hearing Conservationist shall perform the hearing test and the comparison;

e. If an STS is identified and a confirmation audiogram is not performed within 30 days, the STS shall become a confirmed STS by default;

f. If the identified STS is followed by a confirmation audiogram and the confirmation audiogram does not confirm the STS, this second audiogram replaces the first one that suggested the STS;

g. If the identified STS is followed by a positive confirmation audiogram, the better of the two shall become the confirmed STS;

h. An audiologist or physician with hearing conservation experience shall review problem audiograms, including those showing an STS (either by confirmation within 30 days or by default) and shall determine whether there is a need for further evaluation.

i. When further evaluation is warranted, the employee shall be referred to an otolaryngologist or other qualified physician, or to an audiologist for further medical evaluation. See Section 4.8.3.l7, Referrals; and

j. A new baseline reference audiogram shall replace the original or previous baseline audiogram (in separate ears and not both ears, unless both ears meet criteria listed below) when:

(1) The reviewer determines that an STS is persistent on a retest (conducted no sooner than six (6) months later). The baseline shall be revised to the lower (more sensitive) value for the average. Employees assigned a new baseline audiogram, as a result of an STS, shall receive an audiometric re-evaluation six (6) months after this assignment to determine if a further STS has occurred.

(2) A "significant improvement" is shown if the average of thresholds at 2000, 3000, and 4000 Hz for either ear shows an improvement of 5 dB or more from the baseline and the improvement is persistent in the next test. The baseline shall be revised to the lower (more sensitive) value for the average. Age corrections shall not be used when determining "improvement."

(3) An audiologist or physician determines that reasons exist for not revising an employee's baseline audiogram. In such cases, the audiologist or physician must document the reasons for not revising the baseline.

k. The employee, employer, and environmental health staff shall be notified of an STS in writing within 21 days of the determination of the STS;

l. If the employee's uncorrected hearing threshold level, without age correction (averaging 2k, 3k, and 4k Hz) is 25 dB or greater above audiometric zero in the same ear as the STS, a work-relatedness determination shall be made for purposes of OSHA recordability. Based on the best available information, a physician or other licensed health care professional, in consultation with the employer, shall determine, in accordance with CFR 1904.5, whether the noise-induced STS is work-related;

m. Unless a physician has determined that the STS is not work-related, the following actions shall be taken:

(1) The employee's management and responsible safety and health office shall be notified of the occurrence of an STS or other work-related hearing loss.

(2) The work-related hearing loss shall be relayed to the Center's mishap reporting system.

(3) The employee shall be notified and examined by a physician or an audiologist for proper HPD fit.

(4) HPDs shall be re-evaluated for effectiveness, and the employee shall be refitted as necessary with HPDs offering a greater sound attenuation.

(5) The employee shall be trained or retrained on the hazardous effects of noise and the need to use hearing protection.

(6) The work environment(s) shall be investigated to determine if work practices or changes in equipment or procedures have increased the noise hazard. Abatement actions shall be instituted, as necessary, with engineering controls employed first to reduce the potential for exposure to the action level.

(7) Any administrative and work practices being utilized to reduce noise exposures shall be re-evaluated for effectiveness.

n. When an OSHA-recordable STS has occurred, the employer shall record the condition as a hearing loss on the OSHA 300 Log and maintain the record in accordance with 29 CFR 1904, Recording and Reporting Occupational Injuries and Illnesses;

o. The Medical Director shall determine if reassignment to work in a low noise area is indicated to prevent further hearing impairment and shall advise the employer accordingly;

p. The employer shall have ultimate authority and responsibility for employee reassignment; and

q. Where the same employee experiences any subsequent work-related STS as a result of occupational noise exposure, the work environment(s) shall be re-evaluated. If the employee continues to work in the hazardous noise area(s), engineering and/or administrative controls shall be employed that reduce that employee's noise exposure to no more than 50 percent of what was previously allowed for that employee.

4.8.3.17 Employees shall be referred to an otolaryngologist or other physician knowledgeable in hearing conservation or to an audiologist based on the following criteria:

a. Where further medical testing or referrals are needed, the employee shall be notified of the reason for the testing or need for referral;

b. When the examining physician refers an employee to a specialist, communication of relevant medical data shall be provided to the specialist; and

c. The following criteria are based upon the American Academy of Otolaryngology-Head and Neck Surgery referral criteria and shall be used for referral to a qualified physician or otolaryngologist for more comprehensive testing and/or treatment.

(1) Average hearing threshold level at 500, 1000, 2000, and 3000 Hz greater than 25 dB HTL in either ear (Baseline Audiogram).

(2) Difference in average hearing threshold level between the better and poorer ears of more than 15 dB HTL at 500, 1000, and 2000 Hz (Baseline Audiogram).

(3) Change for the worse in average hearing threshold level in either ear compared to the baseline audiogram of more than 15 dB at 500, 1000, and 2000 Hz or more than 20 dB at 3000, 4000, and 6000 Hz (Periodic Audiograms).

(4) Variable or inconsistent responses or unusual hearing loss curves (Periodic Audiograms).

(5) History of ear pain; drainage; dizziness; severe, persistent tinnitus; sudden, fluctuating or rapidly progressive hearing loss; or a feeling of fullness or discomfort in one or both ears within the preceding 12 months (Any Audiogram).

(6) Earwax accumulation sufficient to completely obstruct the view of the eardrum with otoscopy or foreign body in the ear canal.

(7) Failure of any of the above criteria accompanied by ear pain; drainage; dizziness; or severe, persistent tinnitus (Any Audiogram).

(8) When an employee suspects that a medical pathology of the ear is caused or aggravated by the wearing of hearing protectors (Any Audiogram).

4.8.3.18 The latest edition of the American Medical Association Guides to the Evaluation of Permanent Impairment shall be used as a guideline in determining hearing impairment.

4.8.3.19 All HCP/hazardous noise training shall be conducted based on the criteria of this section.

a. Each Occupational Hearing Conservationist shall receive CAOHC certification training. A CAOHC refresher course shall be taken every five (5) years, at a minimum;

b. Occupational health personnel who conduct assessments shall receive initial training on their Center's hearing conservation program and in the hazards of noise exposure;

c. Employees and supervisors of employees enrolled in an HCP shall receive annual training in the hazards of noise exposure; and

d. Annual training in the hazards of noise exposure shall include, at a minimum:

(1) An overview or review of the 29 CFR 1910.95, the Center's and employer's (if a contactor) HCP, and this section.

(2) The effects of hazardous noise and ototoxic substances on hearing (including permanent hearing loss).

(3) Identification of the hazardous noise sources in the employee's work areas.

(4) Factors that may contribute to hearing loss.

(5) Noise-control principles.

(6) An explanation of the audiometric testing procedure and the purpose of audiometric testing.

(7) The employee's role and responsibilities in the HCP.

(8) The purpose of HPD's including:

(a) The advantages, disadvantages, and attenuation characteristics of various types of HPD's;

(b) Instructions on selection, fit, use, and care of HPD's; and

(c) The recommendation that employees use hearing protection whenever there is exposure to hazardous noise during off-duty activities (e.g., lawn mowing, use of firearms).

4.8.3.20 Accurate HCP records shall be maintained as specified in the applicable records retention schedules in NPR 1441.1 and 29 CFR 1910.95 (m), Recordkeeping.

4.8.3.21 Records kept shall fall within the guidelines of NPR 1441.1, NASA Records Retention Schedules and include, but are not limited to:

a. The Center's written HCP and subsequent revisions;

b. A comprehensive registry of all personnel placed in the HCP;*

c. Audiometric tests and records;*

d. Background sound pressure levels of audiometric test rooms;

e. Data and information concerning repair of audiometers;

f. Hazardous noise areas and noise levels recorded in those areas;

g. Survey and dosimetry results and recommendations;*

h. Data and information concerning calibration and repair of sound-measuring equipment;

i. The employee's most recent noise-exposure assessment;

j. Special noise studies;

k. Remedial actions recommended/taken;

l. Engineering controls installed;

m. Results of design and operational reviews;

n. Training; and

o. Hearing protector selection.

NOTE: Items above marked with an asterisk (*) shall be maintained for at least 30 years.

4.8.3.22 Documentation of other official HCP-related activities shall be as follows:

a. Audiometric test records shall include, as a minimum:

(1) Hearing threshold levels at 500, 1000, 2000, 3000, 4000, 6000, and 8000 Hz.

(2) The audiometric reference level to which the audiometer was calibrated at the time of testing.

(3) The date of the audiogram.

(4) The name, employee number, and job classification of the employee tested.

(5) The examiner's name and position.

(6) The date of the last calibration of the audiometer.

b. Audiograms and noise-exposure records shall be maintained as a permanent part of an employee's medical record;

c. When noise-exposure-measurement records are representative of the exposures of other individuals participating in the HCP, and to the extent allowable by the Privacy Act, the range of noise levels and the average noise doses shall be made a permanent part of the medical records of those other individuals; and

d. Consistent with the requirements of the Privacy Act and the restrictions in the "Annual Notice and Amendment to Systems of Records," published in the Federal Register, copies of this section, 29 CFR 1910.95, and any other records required by this section, shall be provided upon written request to:

(1) Employees and former employees and their representatives.

(2) Representatives of the U.S. Department of Labor.

(3) The National Institute for Occupational Safety and Health (NIOSH).

(4) NASA Occupational Health Program personnel.

4.9 Ergonomics

4.9.1 Policy

4.9.1.1 To prevent musculoskeletal disorders (MSD) in the workplace, Centers shall implement an ergonomics program to ensure proper fit between the job tasks, equipment, and the worker performing the duties.

4.9.2 Responsibilities

4.9.2.1 The CHMO shall establish and maintain an ergonomic policy that reflects Federal guidance and best practice initiatives, provide coordination and communication with the NASA Centers, and provide technical and subject matter expertise.

4.9.2.2 OCHMO shall also assess Center compliance with this policy.

4.9.2.3 Center OH Managers shall be responsible for developing and maintaining a written ergonomic program, which complies with the requirements stated in this policy and is consistent with current professional guidance from organizations such as OSHA and NIOSH.

4.9.3 Process Description

4.9.3.1 Each Center shall have a written ergonomics program that includes at least the following elements:

a. Management support and employee participation;

b. Worksite analysis;

c. Job analysis;

d. Medical management;

e. Training; and

f. Program evaluation.

4.9.3.2 Management support of the ergonomics program shall be demonstrated at a minimum by approving a Center ergonomic policy. This starts at program/project initiation with the incorporation of ergonomic principles and requirements in procurement of furniture and equipment. Employees (and their designated representatives) shall have ways to report "MSD signs and symptoms," obtain responses to reports, and participate in developing, implementing, and evaluating each element of the program. Policies or practices shall not discourage employees from participating in the program or from reporting MSD's signs or symptoms. A method for employees to report MSD signs and symptoms and to get prompt responses shall be established. Employee reports of MSD signs and symptoms shall be evaluated to determine whether a MSD has occurred. Information to employees shall be periodically provided that explains how to identify and report MSD signs and symptoms.

4.9.3.3 A worksite analysis shall be performed where existing hazards and conditions exist, and where operations or areas with the potential to create hazards exist. This includes scrutiny and tracking of injury and illness records to identify patterns of traumas or strains that may indicate the development of MSD's. Whenever new ergonomic hazards are introduced to operations, a worksite analysis shall be performed.

4.9.3.4 Operations with significant ergonomic risk factors present shall be analyzed to fully define the ergonomic risk factors that result in MSD hazards. The ergonomic hazards must be eliminated, reduced to the extent feasible, or materially reduced using an incremental abatement process.

4.9.3.5 A medical intervention/management system shall be designed and implemented to eliminate or reduce the risk of development of MSD's through early identification and treatment by qualified medical providers. Concerted efforts shall be made to return employees to work as soon as possible.

4.9.3.6 Employees shall be provided proper ergonomic training to make employees aware of the ergonomics program, MSD hazards, and methods for eliminating MSD hazards.

4.9.3.7 The Ergonomic Program shall be re-evaluated periodically and identified deficiencies corrected. Metrics that document the efficacy of the ergonomics program shall be maintained and used to improve the program and to reduce MSD risks.

4.10 Indoor Air Quality (IAQ)

4.10.1 Policy

4.10.1.1 NASA recognizes the negative impact poor IAQ can have in the workplace on injuries, illnesses, and adverse health symptoms affecting employee productivity, morale, and absenteeism. This requirement establishes minimum standards for all NASA Center IAQ programs with regard to complaint investigation, IAQ testing, communication of IAQ information to employees, mold remediation, recordkeeping, and general requirements.

4.10.2 Responsibilities

4.10.2.1 The CHMO shall establish and maintain an IAQ policy that is reflective of Federal guidance, provide coordination and communications with the NASA Centers, and provide technical and subject matter expertise.

4.10.2.2 The CHMO shall provide IAQ program oversight and assess compliance with this policy.

4.10.2.3 Centers shall ensure that they have a written IAQ program that is designed to ensure all indoor environments are safe and free from recognized hazards for human occupancy.

4.10.2.4 Centers shall ensure that their IAQ programs include provisions for:

a. Investigating IAQ complaints, offering technical guidance and support on minimizing the impact of constructions, renovation, and maintenance activities on IAQ, and recommending corrective actions to resolve all IAQ problems;

b. Evaluating the medical condition of employees who are potentially affected by exposure to indoor air contaminants;

c. Ensuring building heating, ventilation, and air-conditioning (HVAC) system designs and modifications meet recommended standards, including the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) guidelines for relative humidity and temperature, and do not adversely affect local exhaust ventilation systems used to control hazardous materials;

d. Providing housekeeping services that minimize dust accumulation and food wastes and maintain carpets in a manner which is sufficient to minimize the likelihood of IAQ complaints; and

e. Ensuring indoor work areas are free from contaminants (i.e., visible mold, pesticides, ozone from copiers, open chemical containers, outdoor sources, etc.) that contribute to IAQ problems.

4.10.3 Process Description

4.10.3.1 General IAQ investigations shall involve the cooperation of several organizations at a Center, including the affected individuals, industrial hygiene (IH), occupational medicine, building managers, janitorial staff, maintenance, and operations staff.

4.10.3.2 IAQ investigations shall follow four basic steps (these are not necessarily distinct stages and some may be intermixed depending on the situation and discretion of the investigator):

a. Identification of an IAQ concern;

b. Investigation of the IAQ concern. This shall be done by the appropriate IH organization;

c. Collection of appropriate and representative samples; and

d. Evaluation of data, recommendations and conclusions, and report generation.

4.10.3.3 An open, transparent, and effective communication process with affected occupants regarding an IAQ investigation's findings and subsequent correct actions shall be developed and followed for IAQ problems that have affected a significant amount of NASA facility occupants and/or raised serious health concerns. This process shall include both verbal and written communication and shall be continued until the IAQ concern is effectively resolved. Communication efforts shall start at the earliest stages of an IAQ investigation.

4.10.3.4 Employees shall be notified about building conditions and policies that may have a significant adverse IAQ impact (e.g., planned renovation, remodeling, maintenance or pest control activities) on indoor air quality and operational activities.

4.10.3.5 An effective process for moisture control and mold remediation shall be developed at all Centers. When mold is found to be present, the Center shall work with their industrial hygiene organization to develop a plan for remediation. The methods used for mold remediation depend on the type of material and the extent of the area with mold growth but shall be appropriate with current professional guidelines (see Section 4.11.5, References).

4.10.3.6 The following general IAQ requirements shall be incorporated into each Center's IAQ program:

a. Construction and maintenance activities in occupied buildings shall be planned and managed to minimize the release of dust, vapors, fumes, and other air contaminants to protect workers and building occupants. For example, paint vapors shall be minimized using low-emitting products and scheduling or ventilation;

b. The purchase of building and office materials such as carpet, upholstery, cushions, adhesives, and furniture shall be low volatile organic compound emitting and shall not significantly contribute to IAQ problems;

c. Carpet maintenance shall be maintained in an effort to ensure carpets do not become a source of dust, mold, bacteria, and other indoor air contaminants;

d. Integrated pest management techniques shall be used to reduce IAQ problems created during pesticide applications;

e. Parked vehicles, such as those in loading docks, shall not be allowed to remain running in close proximity to building air intakes where exhaust contaminants may get entrained into the building;

f. Designated smoking areas shall not be near air intake systems or entry/exit doors where smoke may be entrained into the building;

g. Water spills and leaks shall be immediately attended to and water leaks reported without delay; and

h. Decorative plants shall be maintained properly as to not create an environment for mold or bacteria.

4.10.3.7 At the conclusion of the IAQ investigation, results shall be evaluated and conclusions and recommendations derived. A summary of this information shall be compiled into a report and distributed to all affected parties.

4.10.3.8 Records shall be maintained to document compliance with this chapter. The following records shall be maintained for all IAQ investigations in accordance with NPR 1441.1, NASA Records Retention Schedules and other applicable NASA recordkeeping requirements:

a. A log of IAQ complaints;

b. All IAQ interview questionnaires and forms;

c. Any monitoring and IH sampling conducted during the investigation; and

d. All IAQ reports with conclusions and recommendations.

4.11 Biosafety

4.11.1 Policy

4.11.1.1 It is NASA policy to protect the health of workers and the public from the risks associated with the use of hazardous biological agents by minimizing or eliminating exposure of workers, other persons, and the outside environment.

4.11.1.2 The scope of this policy is limited to projects that involve direct work and handling of biological hazards. This includes, but is not limited to, non-medical biological laboratory workers and animal handlers. This section encompasses ground processing aspects of biological agents intended for use on flight experiments.

4.11.1.3 This policy does not apply to potential or incidental exposure to biological hazards because of a complication to one's normal industrial work (such as a plumber or custodian) or to clinical medical functions. These aspects shall be covered under program- or project-specific plans and procedures.

4.11.2 Responsibilities

4.11.2.1 OCHMO is responsible for:

a. Assessing biosafety as a portion of their periodic onsite reviews;

b. Reviewing and approving all intended uses of prions prior to their use at any NASA Center or Facility,

or by any NASA or NASA Contractor personnel; and

c. Reviewing and approving all uses of Biosafety Level 3 (BSL-3) agents and Animal Biosafety Level 3 (ABSL-3) animals prior to their presence at any NASA Center or Facility, or use by any NASA or NASA Contractor personnel.

4.11.2.2 Center Medical Directors are responsible for:

a. Designing medical support services in consultation with representatives from the institutional environmental health and safety and principal investigators;

b. Approving all uses of BSL agents and ABSL animals on a case-by-case basis prior to their presence on Center;

c. Approving uses all of genetically-modified agents or recombinant deoxyribonucleic acid (DNA) molecules on an each case basis prior to their presence on Center;

d. Ensuring the clinic is cognizant of potential hazards encountered by the biohazard workers; and

e. Reviewing affected workers previous and ongoing medical conditions, current medications, allergies to medicines, animals, and other environmental proteins and prior immunizations; and determining what medical services are needed to permit safe performance of the duties of the position.

4.11.2.3 Center Environmental Health organizations are responsible for:

a. Reviewing and approving all proposed facility designs and equipment purchases for use with genetically-modified agents or recombinant DNA molecules or Biosafety Level 2 (BSL-2) or higher agents and ABSL or higher animals, prior to their procurements;

b. Reviewing and approving all proposed uses, operational tasks and associated equipment, and containment controls of genetically modified agents or recombinant DNA molecules prior to their use;

c. Reviewing and approving all proposed uses, operational tasks and associated equipment, and containment controls of genetically-modified agents or recombinant DNA molecules or BSL-2 or higher agents and ABSL or higher animals prior to their use. Particular attention shall be given to procedures that impart energy to a microbial suspension or that produce aerosols and the knowledge and experience of the intended user; and

d. Inspecting and certifying biological safety cabinets (BSC) and other containment devices before use and at least annually to ensure they conform to the requirements of this section.

4.11.2.4 Supervisors shall be responsible for:

a. Providing a description of the requirements, proposed tasks, and responsibilities of each position involving hazardous biological agents to the clinic to guide the evaluation; and

b. Cooperating with environmental health professionals to identify the potential worksite health hazards.

4.11.3 Process Description

4.11.3.1 Except as otherwise defined in this policy, Centers shall classify biosafety levels (BSL); provide levels of containment; use the standard practices, safety equipment, facility requirements and training requirements; and handle biological agents, according to the recommended criteria in the Centers for Disease Control (CDC) publication, Biosafety in Microbiological and Biomedical Laboratories (BMBL) 5th Edition. In particular, the standard practices and recommendations for safety equipment and facility requirements in Section IV and Table 1 shall be followed.

4.11.3.2 For purposes of this policy, the risk associated with Animal Biosafety Levels (ABSL) and the BSL described in the CDC BMBL are equivalent. All BSL requirements apply to ABSLs. Equivalent control measures shall be taken to assure personnel safety from potential exposures to animal borne biological agents. The co-application of BSL's and ABSL's shall be determined by a protocol driven risk assessment. The hazard and exposure controls shall be adjusted accordingly.

4.11.3.3 For purposes of this policy, the applicable recommended practices, requirements, safety equipment, training, and facility safeguards described in the latest edition of the following documents and their appendices are mandatory.

(1) Centers for Disease Control (CDC) publication, Biosafety in Microbiological and Biomedical Laboratories (BMBL) 5th Edition, http://www.cdc.gov/od/ohs/biosfty/bmbl5/bmbl5toc.htm.

(2) NIH Guidelines for Research Involving Recombinant DNA Molecules, http://www4.od.nih.gov/oba/rac/guidelines/gui http://www4.od.nih.gov/oba/rac/guidelines/guidelines.html.

(3) United States Department of Transportation (DOT), http://www.dot.gov/.

(4) International Civil Aviation Organization http://www.icao.int/ requirements for transportation of etiologic agents, and infectious substances.

(5) Foreign governments, and the International Civil Aviation Organization, http://www.icao.int/.

(6) Public Health Service Foreign Quarantine regulations, http://www.cdc.gov/ncidod/dq/isolation_quarantine/index.htm.

(7) United States Department of Agriculture requirements, http://www.usda.gov/wps/portal/usdahome.

(8) National Academies Publication, Guide for the Care and Use of Laboratory Animals, http://www.nap.edu/readingroom/books/labrats/.

(9) Public Health Service Foreign Quarantine regulations, http://www.cdc.gov/ncidod/dq/isolation_quarantine/index.htm.

4.11.3.4 Centers and Facilities shall make mandatory use of the required documents in this section for all work with experimentally infected animals housed in research facilities and in the maintenance of laboratory animals that may naturally harbor zoonotic infectious agents.

4.11.3.5 Centers shall develop a written Biosafety Plan that outlines their plan for adhering to the mandatory requirements of the CDC, National Institutes of Health, and United States Department of Agriculture, including provisions for administrative controls, engineering controls, work practices, decontamination, infectious waste management, and disposal.

4.11.3.6 Centers using biologically hazardous substances, agents, and/or animals shall develop a biosafety operations manual that identifies all of the hazards that may be encountered and that specifies practices and procedures designed to minimize or eliminate exposures to those hazards.

4.11.3.7 A risk assessment based on the origin of the cells or tissues (species and tissue type), as well as the source (recently isolated or well characterized) shall be conducted for all work with mammalian tissues or cells. Human and other primate cells shall be handled using BSL-2 practices and containment. All work shall be performed in a BSC and all material decontaminated by autoclaving or disinfection before discarding. Personnel working with human cells and tissues shall work under the policies and guidelines established by the Center's Biosafety Plan and Operations Manual.

4.11.3.8 Centers shall have integrated pest management (IPM) programs that integrate housekeeping, maintenance, and pest control services to control pests such as flies and cockroaches. Each IPM program shall be site-specific, and tailored to the environment where applied. IPM issues and requirements shall be addressed in a facility's planning, design, and construction to provide an opportunity to incorporate features that help exclude pests, minimize pest habitat, and promote proper sanitation in order to reduce future corrections that can disrupt operations.

4.11.3.9 The following biological agents are prohibited from use at all NASA Centers:

a. Selected Agents covered under 42 CFR part 73, http://www.cdc.gov/od/sap/42_cfr_73_final_rule.pdf; 7 CFR 331 and/or 9 CFR 121, http://a257.g.akamaitech.net/7/257/2422/01jan20051800/edocket.access.gpo.gov/2005/pdf/05-5063.pdf ;

b. Prions causing transmissible spongiform encephalopathies; and

c. BSL- 4 biological agents.

4.11.3.10 Centers shall conform to the following requirements when transportating infectious and/or etiologic agents:

a. Materials known to contain or reasonably expected to contain a pathogen (including bacteria, viruses, rickettsiae, parasites, fungi) or other agent, such as a prion, that can cause disease in humans or animals, or infectious substances as purified or concentrated cultures, body fluids, or tissues, shall be appropriately packaged for transportation; and

b. Packages shall be designed to withstand rough handling and other forces experienced in transportation, such as changes in air pressure and temperature, vibration, stacking, and moisture. Hazard communication shall include shipping papers, labels, markings on the outside of packaging, and other information necessary to enable transport workers and emergency response personnel to correctly identify the material and respond efficiently in an emergency situation.

4.11.3.11 Centers shall adhere to the following training requirements when using biologically hazardous substances, agents, or animals:

a. Personnel using biologically hazardous substances, agents, or animals shall be educated about the biohazards to which they may be occupationally exposed, the types of exposures that place their health at risk, the nature and significance of such risks, as well as the appropriate first aid and follow up for potential exposures. They shall read and follow the required practices and procedures and shall consult with safety or health professionals with regard to risk assessment prior to use of those substances or organisms;

b. Refresher training shall be provided at least annually, at the time of any significant change in job responsibility, and follow recognized and suspected exposures;

c. Centers or Facilities conducting BSL 1-3 and ABSL 1-3 level experiments shall use personnel who are adequately trained and experienced in this special work;

d. Personnel using viable biological agents, laboratory animals, genetically modified organisms, and/or recombinant DNA molecules shall be accordingly experienced and knowledgeable in their use; and

e. NASA and NASA Contractor shippers and carriers shall be trained on the applicable transportation regulations so they can properly prepare shipments and recognize and respond to the risks posed by these materials.

4.11.3.12 The following criteria for medical support shall be met by all Centers for work involving hazardous biological agents, substances, and animals:

a. Personnel working with human cells and tissues shall be enrolled in an occupational medicine program specific for bloodborne pathogens. Reference NPR 1800.2, Section 3.2 and Appendix F;

b. Personnel using BSL or ABLS agent, laboratory animals, genetically modified organisms, and/or recombinant DNA molecules shall be fully informed of the available medical support services and encouraged to utilize them;

c. Personnel, who may be occupationally exposed to human pathogens in research settings, shall receive a pre-placement medical evaluation;

d. Medical support services shall be based upon detailed risk assessments and tailored to meet the organization's need and shall be provided for all personnel regardless of employment status. Occupational medical care provided for contractors, students, and visitors by their employers or sponsors shall be equivalent to that provided by NASA for exposures, injuries, or other emergencies experienced at the worksite. Plans for providing medical support for workers shall be completed before work actually begins. The medical provider shall be knowledgeable about the nature of potential health risks in the work environment and have access to expert consultation; and

e. Medical support services for biomedical research facilities shall be evaluated annually. Joint annual review of occupational injury and illness reports by healthcare providers, environmental health, and safety representatives shall be performed to assist in revision of exposure prevention strategies to minimize biological health hazards that cannot be eliminated.

4.11.3.13 Disposal of wastes contaminated with biological agents, genetically modified agents, recombinant DNA molecules, and/or potentially infectious materials shall be handled in accordance with the Center's infectious, biological, and/or hazardous waste disposal procedures and policies. Prion-contaminated instruments and other materials shall be discarded and destroyed by incineration with a minimum secondary temperature of 1000 degrees C (1832 degrees F).

4.12 Food Safety

4.12.1 Policy

4.12.1.1 NASA shall mitigate potential food safety hazards by establishing a primary prevention approach to food safety that encompasses planning and reviews of all proposed projects, processes, and procedures to mitigate potential food safety hazards.

4.12.1.2 The Food and Drug Administration (FDA) Food Code shall be the minimum standard for food service operations at NASA facilities.

4.12.1.3 Food safety shall be accomplished through the implementation of Hazard Analysis Critical Control Point (HACCP) principles, risk-based inspections and controls, and FDA-recommended program standards.

4.12.1.4 Overall authority for Agency food safety is delegated to the NASA Senior Environmental Health Officer (SEHO) by the NASA Director of Occupational Health.

4.12.1.5 Where conflicts between the latest FDA Food Code, this section of NPR 1800.1 and any additional state or local "food code" requirements exist, whichever is most protective shall be applied. Centers shall coordinate questionable conflicts between the latest FDA Food Code and this section of NPR 1800.1 with the SEHO and shall coordinate questionable conflicts between either the FDA Food Code or this section of the NPR with state and local "food code" with the local authorities.

4.12.1.6 This section does not apply to spaceflight operations.

4.12.2 Responsibilities

4.12.2.1 The CHMO shall be responsible for managing, evaluating, and reviewing the NASA Food Safety Program to ensure compliance with regulatory and Agency requirements. Specifically, the CHMO shall be responsible for:

a. Providing technical guidance to Centers' food service organizations on related food safety matters/concerns;

b. Periodically conducting surveys/inspections of each Center's food services for compliance with NASA requirements and applicable local, state, and Federal regulations;

c. Investigating Agency-wide complaints associated with food safety concerns;

d. Coordinating with outside agencies, as applicable, on food safety and related environmental health matters; and

e. Notifying, by the most expeditious means, the Agency Director of Occupational Health of food-related incidents as they are reported by the Centers.

4.12.2.2 Center Directors, including Headquarters (HQ) and Component Facility Directors, shall be responsible for:

a. Ensuring compliance with the provisions in this section; and

b. Ensuring all Center Food Safety Program elements are implemented and maintained.

4.12.2.3 Centers shall be responsible for:

a. Providing for design/procedure reviews, technical assistance, and consultation with all Center organizations on matters concerning food sanitation;

b. Performing at least quarterly, onsite, risk-based, food safety audits of food establishments; identifying and assessing the hazards and associated risks; determining and implementing critical controls and procedures necessary to reduce risk of foodborne illness; and providing a program of active managerial control;

c. Maintaining accurate and complete survey and inspection data records for the last three months or last three inspections, whichever time span is greater;

d. Providing consultation in the preparation of state and/or local permit applications for food service activities and maintaining copies of those documents and permits, with associated records, to ensure compliance monitoring and reporting is carried out in a timely manner;

e. Identifying and providing support concerning certification and training requirements for food managers and food service workers in order to promote a comprehensive awareness and active managerial control of risk factors most commonly associated with foodborne illnesses;

f. Notifying, by the most expeditious means, the CHMO of major food-related incidents as they are reported;

g. Correcting all inspection violations in a reasonable length of time;

h. Notifying their local and state health departments, the CDC, and/or the Department of Homeland Security, as applicable, of foodborne disease outbreaks;

i. Assuring that food handler physical examinations are provided to food services workers, through NASA Health Clinics, for individuals who work at food establishments on NASA property or under NASA jurisdiction and conducted in accordance with the requirements of Chapter 2.9 of this NPR;

j. Maintaining current food safety policy, and/or procedures, which assign responsibility, accountability, and authority to pertinent Center organizations, departments, and employees;

k. Assuring that Center Senior Management is routinely appraised of the status of food safety issues and problems;

l. Assuring that food sanitation personnel and food inspection personnel are included in the procurement of food establishment equipment and facility design reviews;

m. Assuring that food establishments implement food management plans that incorporate active managerial control, HACCP principles, training requirements, hygiene standards, cleaning and sanitary practices, illness reporting agreements, food hazards of significance, monitoring procedures, record keeping, corrective action processes, and proper certification of food service workers and food inspection personnel;

n. Assuring that food service personnel report symptoms of illness that may be transmissible through food; and

o. Assuring that Critical Control Points and Critical Limits are included in recipes or recipes are controlled via an overall policy that provides time and temperature limits based on the current FDA Food Code.

4.12.3 Process Description

4.12.3.1 All food served or vended at NASA Centers and Component Facilities shall be clean and free of pathogenic organisms, contamination, and organic or inorganic toxins (including those of bacterial origin). This applies to transporting, storing, preparing, serving, and vending of food provided/available at NASA Centers and Component Facilities. This applies equally to all appropriated funded, non-appropriated funded, organizational, contractor, and/or private association food activities held on NASA Centers and Component Facilities.

4.12.3.2 Centers and Component Facilities shall comply with HACCP principles and the United States Department of Health and Human Services (HHS), FDA Food Code.

4.12.3.3 Centers shall have a written food safety policy that requires them to ensure that an HACCP or equivalent management system includes and implements a process of self-inspection and continuous improvement. The management system shall provide for active managerial control and the purposeful incorporation of specific actions or procedures into the operation of food service establishments to attain control over foodborne illness risk factors. Unique conditions within each facility shall be considered during the development of food safety plans. A generic plan is not acceptable. The food safety plan shall identify potential hazards of significance and include preventive measures to ensure and improve food safety. Critical Control Points shall be effectively controlled.

4.12.3.4 Constraints/controls imposed upon substances/operations subject to the provisions of this section shall be no less than those required by applicable regulatory authorities and shall include any additional special constraints deemed necessary by the NASA SEHO as a result of unique or operational characteristics.

4.12.3.5 All records generated by following these procedural requirements, including but not limited to those required by local, state, or Federal statute or regulation, and the most recent edition of the FDA Food Code, shall be maintained in accordance with NPR 1441.1, NASA Records Retention Schedules.

4.12.3.6 All records shall be available for review by the NASA SEHO or designee and Federal, state, and/or local food safety inspectors. Examples of records include applicable training records, inspection records, temperature logs, food receiving logs, maintenance logs, and dishwasher logs.

4.12.3.7 Waivers from some or all NASA Food Safety Program requirements described in this section shall be determined on a case-by-case basis by the NASA SEHO. Requests for waivers shall be submitted to the NASA SEHO in writing for approval by the CHMO prior to their initiation. Authorizations may be withdrawn at any time for violations of the granted waiver or other regulatory non-compliance. Centers shall provide copies of requests for waivers to the OSMA if they are deemed to affect the NASA workforce, and the appropriate union, as applicable.

4.12.3.8 Where Agency surveys or inspections indicate non-compliance with NASA-approved procedures and controls, the responsible organization for that activity shall correct all discrepancies and notify the NASA SEHO and the Center OH Office when remediation has been completed.

4.12.3.9 The NASA SEHO and the Center OH Office shall be immediately advised of major accidents, incidents, or emergencies involving food safety.

4.12.3.10 Centers shall:

a. Ensure that the requirements and provisions of this section are included in all food and beverage services contracts, subcontracts, and other applicable contracts;

b. Conduct a continuing program of inspection and surveillance of all food establishments by individuals who are qualified by training, certification, or standardization to conduct food service inspection and

surveillance.

c. All Center food service establishments shall meet or exceed the minimum acceptable requirements established by NASA directives, as well as applicable Federal, state, and local regulations for the safe handling of food;

d. Remove from service or sale all food items suspected to be contaminated, unwholesome, or otherwise deemed unfit for consumption;

e. Ensure design reviews are conducted for new or redesigned food establishments, as well as for facilities that intend to make significant changes to the existing menu or theme;

f. Review plans for temporary events and provide recommendations concerning food safety provisions;

g. Ensure that Center policy requires prompt notification of a responsible individual in the event of an emergency that might contaminate food or prevent potentially hazardous food from being held at safe temperatures;

h. Ensure that training is provided to maintain any certification requirements food service employees may need;

i. Maintain the most recent copy of the inspection form and have it available for review by inspection personnel and food installation customers;

j. Ensure all food handlers report to the Center medical clinic or their personal physician when any symptoms of infections and/or communicable diseases are present;

k. Ensure that all food handlers returning to work after an illness-related absence associated with any of the conditions below are medically cleared:

(1) A diagnosed illness of Norovirus, typhoid fever (Salmonella typhi), shigellosis (Shigella spp.), E. Coli O157:H7 infection (or other EHEC/STEC (enterohemorrhagic or Shiga

toxin-producing E. Coli), or hepatitis A virus (hepatitis A).

(2) Symptoms of gastrointestinal illness such as diarrhea, fever, vomiting, jaundice, or sore throat with fever.

(3) A lesion, boil, or wound containing pus that is open or draining and is on the hands, wrists, or exposed portions of arms.

(4) Illness from consuming food that was implicated in or caused an outbreak.

l. Ensure that organizations operating vending machines that dispense food or beverages provide the Center OH Office with a list of onsite vending machines and their locations where potentially hazardous food items are dispensed;

m. Ensure that food handler physical examinations are provided and Hepatitis A inoculations made available to food services workers through NASA Health Clinics for individuals who work at food establishments on NASA property or under NASA jurisdiction;

n. Maintain current food safety policy, and/or procedures, which assign responsibility, accountability, and authority to pertinent Center organizations, departments, and employees;

o. Ensure that Center Senior Management is routinely apprised of the status of any food safety issues;

p. Ensure that food establishments' food management plans are established to implement sound food safety practices;

q. Ensure that Critical Control Points and Critical Limits are included in recipes or an overall food policy provides time and temperature limits based on the current FDA Food Code; and

r. Ensure that vermin are controlled to prevent the creation of a health hazard to humans.

4.12.4.11 New and redesigned facilities shall be reviewed by the Center OH Office and meet the principles outlined in state and local codes and the FDA Food Code, unless they cannot be technically accomplished. All design deviations and changes that may affect the Center's Food Safety Program requirements shall be coordinated with appropriate Center personnel and approved in advance by the Center's OH representative.

4.12.4.12 All Centers' bottled water dispensers shall be in compliance with Federal, state, and local regulations.

4.12.4.13 Only bottled water approved by the Center shall be placed in bottled water dispensers. Under

no circumstances, shall empty bottles be refilled by anyone other than the processor.

4.12.4.14 All organizations procuring bottled water shall ensure that:

a. No bottled water dispensers are allowed or bottles of water stored in areas where general hazards or contamination of any kind pose a threat to users under normal operations;

c. Bottled water dispensers are maintained in a sanitary condition; and

d. All dispensers have equipment numbers.

4.13 Radiation, General

4.13.1 Policy

4.13.1.1 NASA Centers shall maintain and preserve the health of the NASA workforce by minimizing occupational exposures, eliminating unnecessary exposures, and reducing the potential for accidental exposures to ionizing and non-ionizing (laser, radio frequency, and non-laser optical) radiation.

4.13.1.2 Exposures to ionizing radiation shall be kept ALARA.

4.13.1.3 NASA Centers shall achieve these objectives by the use of firm management controls, safe operating procedures, appropriate equipment, a comprehensive maintenance and surveillance program, adequate shielding, and distance or by limiting personnel exposure time.

4.13.2 Responsibilities

4.13.2.1 The CHMO shall establish and maintain a system of procedures and guidance based on Federal and state regulations and national and international radiation protection standards and recommendations.

4.13.2.2 The SEHO shall serve as the Agency Radiation Safety Manager providing program oversight and assessing compliance.

4.13.2.3 The OSMA shall maintain purview concerning the launching of radioactive materials in accordance with NRP 8715.3 NASA General Safety Program Requirements.

4.13.2.4 Centers shall establish radiation protection programs, staffed with competent personnel, for centralized control and accountability over sources of ionizing and non-ionizing radiation and ensure compliance with applicable Federal, state, and local requirements through independent quality assurance checks. Centers shall also ensure that adequate personnel, facilities, equipment, training, and operational and emergency controls are maintained for all operations utilizing ionizing or non-ionizing radiation and that such sources are used safely and in accordance with written procedures based on sound radiation protection and engineering principles.

4.13.3 Process Description

4.13.3.1 Each Center in which operations exist which expose workers or the public to ionizing and non-ionizing radiation shall administer a comprehensive radiation protection program to identify and control those radiation exposures in accordance with this chapter.

4.13.3.2 The radiation protection program shall be implemented by written procedures and reviewed at least once every 12 months to evaluate its content and implementation. Whenever practical, this review shall be performed by personnel who do not have direct responsibility over the program. At a minimum, the review shall cover procedural compliance, technical adequacy, implementation, and effectiveness of the program. The annual review shall be documented and provided to the Agency Radiation Safety Officer.

4.13.3.3 Training shall be provided according to the following criteria:

a. Only persons qualified by training shall be authorized to use ionizing or non-ionizing radiation;

b. Training shall be commensurate with the potential hazards and provided prior to unescorted access to restricted areas and prior to receiving occupational exposure during access to restricted areas;

c. Initial and recurrent training shall provide the knowledge, skills, and abilities necessary for maintaining radiation individuals' doses below applicable limits. It shall also provide workers with an understanding of the risks associated with radiation and the means for recognizing and addressing workplace hazards that may lead to increased risks; and

d. Female radiation workers who may be occupationally exposed to the radiation dose threshold (i.e., 100 millirem [mrem]) and their supervisors shall also receive special instructions on the potential health

risks of prenatal exposure to ionizing radiation.

4.13.3.4 Physical examinations shall be conducted in accordance with the requirements of Chapter 2.9.

4.13.3.5 A comprehensive inventory of all hazardous ionizing, laser, and Radio Frequency (RF)/microwave sources shall be maintained and periodically verified.

4.13.3.6 A formalized approval process based on hazards analyses shall be implemented prior to the authorization of any source of hazardous ionizing and non-ionizing radiation.

4.13.3.7 To the maximum extent practical, hazards to personnel shall be eliminated by engineering design.

4.13.3.8 Procedures shall be developed or equipment provided to mitigate those hazards that cannot be eliminated by engineering design.

4.13.3.9 Work activities shall be conducted as specified by the controlling written authorization.

4.13.3.10 All sources of ionizing and non-ionizing radiation, whether in use or in storage, shall be controlled and secured from unauthorized access or removal according to the following criteria:

a. Controls shall be commensurate with the hazards and provide flexibility for consideration of other hazards (e.g., industrial safety, industrial hygiene, environmental hazards);

b. Use and storage locations shall afford adequate safety and security;

c. Postings and labeling shall be done in compliance with applicable regulations, this NPR, and other appropriate NASA policies;

d. Restricted areas shall be established and posted to warn individuals that they are entering areas controlled for radiation protection purposes. Access shall be limited to authorized personnel;

e. Smoking, eating, and drinking are prohibited in restricted areas; and

f. Any activity involving ionizing or non-ionizing radiation determined to be a threat to health or property shall be immediately terminated.

4.13.3.11 Written operating, maintenance, service, and emergency procedures shall be provided and maintained with the ionizing or non-ionizing radiation source for easily accessible reference. These procedures shall be commensurate with the hazards, activity, and the education, training, and skills of the individuals who are exposed to the hazards.

4.13.3.12 Personnel trained to evaluate and document the magnitude and extent of radiation emissions and potential radiological hazards and to verify the efficacy of controls and procedures shall periodically perform surveillance and monitoring of approved facilities, equipment, and operations in accordance with the following specifications:

a. Surveillance and monitoring shall be conducted at a frequency based on applicable regulatory requirements, and license conditions and that is commensurate with the potential for changes in the radiation fields and the potential magnitude of the changes;

b. Instrumentation that is used to perform radiation surveys shall be capable of measuring accurately the types of radiation, at the dose rates and under the environmental conditions that may be encountered;

c. Instruments and equipment used for quantitative radiation measurements shall be calibrated for the radiation measured at intervals not to exceed 12 months or per the manufacturer's recommendation;

d. When any component affecting the radiation safety of a system is serviced or replaced, a qualified expert shall perform a survey of the installation to ensure continuity of adequate personnel radiation safety; and

e. Surveillance and monitoring results shall be evaluated and investigations initiated to resolve unexpected results.

4.13.3.13 Exposures to ionizing and nonionizing radiation in excess of the applicable regulatory limits shall be reported to the appropriate regulatory authorities and to OCHMO.

4.13.3.14 Records shall be maintained to document compliance with this chapter, applicable regulations and standards, and with the provisions of Center radiation protection programs. Unless otherwise specified in this chapter, records shall be retained until final disposition is authorized by NASA per NPR 1441.1D, NASA Record Retention Schedules.

4.14 Radioactive Materials

4.14.1 Policy

4.14.1.1 It is NASA policy that the receipt, use, storage or transfer of radioactive materials, or equipment containing such materials, be controlled.

4.14.1.2 NASA Centers shall consider the following as radioactive materials: byproduct, source, or special nuclear material; naturally occurring radioactive material in any other form, or quantity/concentration greater than that found in the natural environment; accelerator-produced radioisotopes; generally licensed items or devices acquired under the general license provisions of Title 10 Code of Federal Regulations (CFR) Part 31, "General Domestic Licenses for Byproduct Material," or issued under the provisions of an Agreement or Nonagreement State; and radioactive waste.

4.14.2 Responsibilities

4.14.2.1 Center Senior Management shall designate competent and qualified personnel to administer a program for control and accountability of radioactive materials.

4.14.2.2 Center Radiation Safety Officer (RSO) and/or Radiation Safety Committee, if applicable, shall oversee ionizing radiation safety; approve radioactive material usage; ensure activities involving radioactive materials are conducted in accordance with applicable NRC, OSHA, DOT, International Air Transport Association (IATA), state, and NASA requirements, and take prompt corrective measures to appropriately manage or control hazards.

4.14.3 Process Description

4.14.3.1 Each Center with operations potentially exposing workers or the public to ionizing radiation from radioactive materials shall develop written procedures to identify and control those radiation exposures in accordance with this chapter. Operations and activities shall include reasonable controls directed toward reducing exposure, preventing the spread of radiological contamination, and minimizing the generation of contaminated wastes and the release of effluents.

4.14.3.2 All personnel dosimeters that require processing to determine the radiation dose and are used to comply with dose limits shall be processed and evaluated by a dosimeter processor holding current personnel dosimetry accreditation from the National Voluntary Laboratory Accreditation Program (NVLAP) of NIST.

4.14.3.3 Activities involving radioactive materials shall be conducted in accordance with applicable NRC or NRC Agreement State issued licenses for radioactive materials. Installations using sealed gamma-ray sources shall comply with American National Standard N43.3-2008.

4.14.3.4 Personnel using radioactive material must receive radiation safety training in accordance with 10 CFR 19. The training shall also be reflective of guidance contained in NRC Regulatory Guide 8.29. In addition, special training consistent with NRC Regulatory Guide 8.13 shall be provided to females who may be occupationally exposed to the radiation dose threshold (i.e., 100 mrem) and their supervisors.

4.14.3.5 The following criteria shall be met for all operations involving radioactive materials:

a. All procurement, use, storage, transfer, and disposal of radioactive materials shall be pre-approved by the RSO or Radiation Safety Committee, as appropriate;

b. Radioactive materials shall be shipped in accordance with requirements of the DOT as specified by Title 49 of the Code of Federal Regulations (CFR) Part 172, Subpart H and the NRC as specified by 10 CFR 71.5 and 10 CFR 20.1906;

c. Control of radioactive contamination shall be achieved by using engineering controls and worker performance to contain contamination at the source, reducing existing areas of contamination, and promptly decontaminating areas that become contaminated. A surface shall be considered contaminated if either the removable or total radioactivity exceeds NRC Regulatory Guide 1.86 levels. Contaminated surfaces shall be controlled in a manner commensurate with the physical and chemical characteristics of the contaminant, the radionuclides present, and the fixed and removable contamination levels. Contamination levels caused by ongoing work shall be monitored and maintained as ALARA. Additional contamination limits are provided in Appendix Q of NUREG 1556, Volume 7;

d. The dose limits in 10 CFR 20 shall not be exceeded;

e. Operations must be conducted in a manner to maintain exposures ALARA;

f. Radiation levels in unrestricted areas shall be controlled and demonstrate that no person in an unrestricted area can receive a dose equivalent of 2 mrem in any one hour or 100 mrem in one year;

g. To accomplish NASA's objective of maintaining individual doses below regulatory limits and ALARA,

each Center shall establish administrative control levels below the regulatory dose limits; and

h. Radiation protection to the embryo or fetus of a pregnant female worker shall be provided in a manner that does not discriminate against the rights of the declared pregnant radiological worker.

4.15 Radiation-Generating Equipment

4.15.1 Policy

4.15.1.1 It is NASA policy that radiation protection requirements be instituted for electronic radiation-generating equipment (e.g., x-ray machine, particle beams) and equipment that produces radiation incidental to its operation (e.g., electron microscope).

NOTE: Radiation-generating equipment is defined as devices which produce ionizing radiation without the use of radioactive material.

4.15.2 Responsibilities

4.15.2.1 Center Senior Management shall designate competent and qualified personnel to administer a program for control and accountability of radiation-generating equipment.

4.15.2.2 The Center RSO and/or Radiation Safety Committee (as applicable) shall oversee ionizing radiation safety; approve radiation generating equipment usage; ensure activities involving radiation-generating equipment are conducted in accordance with applicable OSHA, state, and NASA requirements, and take prompt corrective measures to appropriately manage or control hazards.

4.15.3 Process Description

4.15.3.1 Each Center with operations potentially exposing workers or the public to ionizing radiation from radiation-generating equipment shall develop written procedures to identify and control those exposures in accordance with this chapter.

4.15.3.2 All personnel dosimeters that require processing to determine the radiation dose and are used to comply with the dose limits shall be processed and evaluated by a dosimetry processor holding current personnel dosimetry accreditation from the NVLAP of the NIST.

4.15.3.3 Personnel using radiation-generating equipment must receive radiation safety training in accordance with 10 CFR 19. The training shall also be reflective of guidance contained in NRC Regulatory Guide 8.29. In addition, special training consistent with NRC Regulatory Guide 8.13 shall be provided to females who may be occupationally exposed to ionizing radiation and their supervisors.

4.15.3.4 The following criteria shall be met for all radiation-generating equipment:

a. All procurement, use, transfer, and disposal of radiation-generating equipment shall be pre-approved by the RSO or Radiation Safety Committee, as appropriate;

b. Design and operation of installations using non-medical x-ray shall comply with American National Standard N43.3-2008;

c. Design and operation of installations using x-ray diffraction and fluorescence analysis equipment shall comply with the requirements contained in American National Standard N43.2-2001;

d. Certified cabinet x-ray systems shall be surveyed at intervals not to exceed 12 months to ensure compliance with 21 CFR 1020.40 performance standards;

e. Diagnostic x-ray systems shall be surveyed at intervals not to exceed 24 months to ensure compliance with 21 CFR 1020.30 and 1020.31 performance standards;

f. Diagnostic x-ray systems shall be operated in accordance with a 21 CFR 1000.55 compliant quality assurance program;

g. Special considerations for particle accelerator operations shall include the presence of extremely high dose rates, high energy and heavy particles, activation products, and detection and monitoring difficulties associated with pulsed or high energy radiation;

h. The dose limits in 10 CFR 20 shall not be exceeded;

i. All operations involving ionizing radiation shall be conducted in a manner to maintain exposures ALARA;

j. Radiation levels in unrestricted areas shall be controlled and demonstrate that no person in an unrestricted area can receive a dose equivalent of 2 mrem in any one hour or 100 mrem in any one year; and

k. Radiation protection to the embryo or fetus of a pregnant female worker shall be provided in a manner that does not discriminate against the rights of the declared pregnant radiological worker.

4.16 Laser and Non-laser Optical Radiation

4.16.1 Policy

4.16.1.1 NASA centers shall implement protective requirements for use of lasers and sources of hazardous non-laser optical radiation.

4.16.2 Responsibilities

4.16.2.1 Agency Radiation Safety Manager shall resolve conflicts between NASA, Federal Aviation Administration (FAA), U.S. Space Command, and U.S. Military.

4.16.2.2 Center Senior Management shall designate competent and qualified personnel to administer a program for control and accountability of laser and non-laser optical radiation sources.

4.16.2.3 Center Laser Safety Officer (LSO) or Laser Safety Committee (LSC), as applicable, shall oversee laser and non-laser optical radiation source safety; approve laser and non-laser optical radiation source usage; ensure activities involving laser and non-laser optical radiation sources are conducted in accordance with applicable OSHA, state, and NASA requirements; and take prompt corrective measures to eliminate hazards.

4.16.3 Process Description

4.16.3.1 Each Center with operations potentially exposing workers or the public to laser or hazardous non-laser optical radiation shall develop written procedures to identify and control those radiation exposures in accordance with this chapter. Requirements shall be based on laser classification and ancillary non-beam hazards.

4.16.3.2 General laser operations and hazard evaluations shall conform to the principles and requirements set forth in ANSI Z136.1.

4.16.3.3 Outdoor laser operations shall follow the requirements of ANSI Z136.6.

4.16.3.4 All personnel working with class 3b and 4 lasers and hazardous sources of non-laser optical radiation shall be appropriately trained in safe work practices for controlling or mitigating personal exposures. Training shall be provided to employees working with or potentially exposed to Class 1M, Class 2, Class 2M, or Class 3R laser radiation if used outdoors. The level of training shall be commensurate with the degree of potential laser hazards, both from the laser radiation and non-beam hazards.

4.16.3.5 All uses class 3b and 4 lasers and laser systems shall require a hazard assessment and approval by the LSO or LSC, as appropriate, whether indoors, outdoors, ground based, or airborne.

4.16.3.6 Prior to approval of the Use Authorization, hazards to personnel shall be eliminated, or procedures shall be developed and equipment provided to control those hazards that cannot be eliminated by engineering design.

4.16.3.7 Protective measures shall be employed to ensure that personnel are not exposed to laser and non-laser optical radiation in excess of the maximum permissible limits.

4.16.3.8 Except for lasers used in research, only laser products that comply with Federal Performance Standards shall be procured or manufactured, unless a specific exemption is obtained from the FDA.

4.16.3.9 Class 1 laser systems containing embedded lasers shall be controlled according to the classification of the embedded laser when engineering controls (e.g., enclosures, interlocks) are defeated.

4.16.3.10 All outdoor laser operations shall meet the following requirements:

a. All outdoor uses of outdoor lasers require LSO and/or LSC approval prior to use. Caution shall be exercised to prevent visual interference in flight hazard zones established around airports;

b. A comprehensive outdoor laser use assessment shall be documented for all Class 3b and Class 4 outdoor lasers;

c. To ensure against inadvertent laser emissions and to mitigate potential catastrophic events, approval of airborne laser operations shall rely on a combination of interlocks and high-speed shutdown systems, as deemed necessary by engineering analyses;

d. Software shall be utilized to provide safety precautions for fast-moving lasers and prevent misdirected laser operation. Laser software development shall be subjected to a software safety analysis per NPR 8715.3, Chapter 3, NASA General Safety Program Requirements. Existing systems are exempt but shall be reviewed to ensure the provision of safety precautions; and

e. Centers shall advise the Agency Radiation Safety Officer of all outdoor laser coordination with the FAA, U.S. Space Command, and/or local military commands and shall copy the Agency Radiation Safety Officer on all outdoor laser correspondence with the FAA, U.S. Space Command, and/or local military commands. This includes all requests for letters of non-objection from the FAA and all other coordination of matters arising from outdoor lasers. Objections to the use of specific outdoor lasers by the FAA or the U.S. Military shall be honored until the CHMO, in conjunction with other NASA organizations, reviews the complaint and authorizes continuation of operations.

4.16.3.11 Maximum permissible exposures for laser radiation are given in ANSI Z136.1. The occupational exposure limits for non-laser optical radiation are contained in ACGIH Threshold Limit Values for Chemical Substances and Physical Agents & Biological Exposure Indices.

4.17 Radio Frequency Electromagnetic Radiation

4.17.1 Introduction

4.17.1.1 NASA Centers shall implement radiation protection requirements to prevent or control potential risks associated with exposure to electromagnetic fields from RF and microwave sources that operate in the frequency range of 3 kHz and 300 GHz, including, but not limited to: radar systems; spacecraft and vehicle telemetry and communications systems; earth stations; microwave diathermy units; radio frequency generators; and RF heat sealers. Hazards of electromagnetic radiation to ordinance are beyond the escape of this document. Refer to the NASA Explosives Safety document, NSS 1740.12.

4.17.2 Responsibilities

4.17.2.1 Center Senior Management shall designate competent and qualified personnel to administer a program for control and accountability of RF and microwave radiation devices.

4.17.2.2 The Center Radio Frequency Safety Officer shall oversee RF and microwave safety; approve RF and microwave radiation equipment usage; ensure activities involving RF and microwave equipment are conducted in accordance with applicable OSHA, state, and NASA requirements, and take prompt corrective measures to eliminate hazards.

4.17.3 Process Description

4.17.3.1 Each Center with operations potentially exposing workers or the public to non-ionizing radiation from RF and microwave generating equipment shall develop written procedures to identify, document, and control those radiation exposures in accordance with Institute of Electrical and Electronics Engineers (IEEE) Standard C95.7.

4.17.3.2 Techniques and instrumentation for the measurement and computation of potentially hazardous RF radiation both in the near field and the far field of the RF or microwave source, including contact voltage and contact and induced currents, shall be in accordance with IEEE Standard C95.3.

4.17.3.3 All personnel likely to exceed 20 percent of the maximum permissible exposure limit for controlled environments shall be appropriately trained in safe work practices for controlling or mitigating personal exposures.

4.17.3.4 RF and microwave radiation source approvals shall be based on documented RF exposure assessments which include direct measurements when practicable.

4.17.3.5 Operations and activities shall include reasonable controls directed toward reducing exposure. Such controls include engineering and administrative controls as well as the use of personal protective equipment, placement of appropriate RF safety signage, designation of restricted access areas, the use of personal RF monitors, and RF safety awareness training.

4.17.3.6 The beam height of RF and microwave transmitters shall be maintained at a level that does not intercept occupied facilities or structures, or personnel within the identified hazard distance.

4.17.3.7 Limits for maximum permissible exposure and induced and contact RF currents shall be derived in accordance with IEEE Standard C95.1.

4.17.3.8 Limits for lower frequency electromagnetic fields and static magnetic fields shall be in accordance with American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices.

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